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ORIGINAL COMMUNICATIONS.

Tracheo-Bronchial Diphtheria. Dr. H. L. LYNAH, New York City 1193

A Plea for the Electro-Cautery in the Treatment of Laryngeal Tuberculosis. Dr. S. IGLAUER, Cincinnati 1237

Report of a Case of Spontaneous Hemorrhage from the Ear. Dr. J. B. SHAPLEIGH, St. Louis 1241

Ruptured Aneurysm into the Mediastinum and Deep Cervical Fascia with Symptoms of Ludwig's Angina. Report of Three Cases. Dr. E. H. HOLMES, Boston 1246

Epithelioma of the Larynx Treated by Radium. Dr. C. G. COAKLEY, New York 1250

The Use of "Tissue Juices" for the Control of Bleeding in Tonsillectomy. Dr. J. B. GREENE, Asheville, N. C. 1254

SELECTED ABSTRACTS.

A Direct and Rational Method in the Treatment of Fractures of the Lower Jaw. Dr. CAVALIE 1245

Gluck's Laryngectomy in Cancer of the Larynx. R. BOTEY 1253

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LARYNGOSCOPE.

VOL. XXVI. ST. LOUIS, OCTOBER, 1916. No. 10.

ORIGINAL COMMUNICATIONS.

(Original Communications are received with the understanding that they are contributed exclusively to THE LARYNGOSCOPE.)

TRACHEO-BRONCHIAL DIPHTHERIA.*

DR. HENRY LOWNDES LYNAH, New York City.

In tracheo-bronchial diphtheria, the membrane may cause primary stenosis in one of these localities and spread to the other from above downward, and from below upward. In other words, it may occur in the trachea and travel downward, or it may start primarily in the bronchi and travel upward. The membrane may be parietal and occupy only a small portion of the lumen, or it may be in the form of a long ribbon, a cylinder, or a solid cast, partially or completely obstructing the entire respiratory tract.

I am firm in my belief that the great majority of these membranous stenoses travel from below upward, and this statement is borne out by direct laryngeal and bronchoscopic examination on cases recognized prior to the third day of the disease, the larynx not being involved, and diphtheritic membrane encountered only when the lower trachea and bronchi are reached when the foreign body obstruction is plainly visible.

If in all of these cases the membrane started primarily in the larynx we would never fail in our diagnosis, for the constricted cough of the laryngeal type would put us on our guard; but such is not the case in these low membranous types of diphtheria. This condition starting primarily in the bronchi is, I feel, overlooked in

*Read before the American Laryngological, Rhinological and Otological Society, White Sulphur Springs, W. Va., May 5, 1916.

many instances and diagnosed broncho-pneumonia. If one will only bear in mind that there is such a disease as bronchial diphtheria which may be mistaken for broncho-pneumonia, and be constantly on the lookout for the former condition, I can see no reason why any grave error in diagnosis should be made. I wish to make myself perfectly clear on this point, and not lead anyone to be-

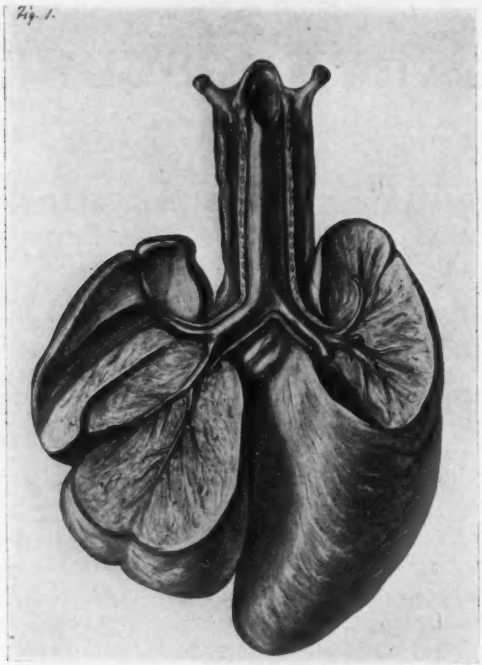

Fig. 1. Case 5. Cast of membrane carefully dissected out after stuffing with cotton and plaster of paris. Showing complete obstruction of the whole tracheobronchial tree. The lungs were increased in volume and the areas about the main bronchi were necrotic. Drawing is semi-diagramatic.

lieve that I consider all of the secondary and latent pneumonias tracheo-bronchial diphtheria; I am speaking of the primary involvement of the lung, accompanied by marked cyanosis early in the disease, asthmatic dyspnea and peculiar but constant physical signs distinctive of bronchial obstruction.

Nasal, tonsillar and pharyngeal exudates are absent in many of these cases when the disease has been recognized earlier than the

third or fifth day. Culture returns taken from cases without visible exudate on the tonsils or pharynx are invariably negative, for it is impossible by the ordinary methods of taking cultures to reach the site of the local lesion. On the other hand, many cultures may give negative results even when taken through the direct speculum

Fig. 2. Case 7. Cast removed by Dr. W. T. Cannon while performing repeated intubations with long tubes while I was on the way to the hospital to bronchoscope the patient. Cast coughed out on removal of a long intubation tube.

Fig. 3. Case 18. Parietal casts removed by bronchoscopy from the trachea.

or the bronchoscope. Recently I was called to see a case of low membranous diphtheria of five days' duration. In this case the family physician argued that a series of cultures taken from the throat were negative, and furthermore, there was no exudate on the tonsils, nor was there any nasal discharge. It was next to impossible to convince this physician of the true nature of the disease

even when he saw for himself through the direct speculum a mass of membrane. I only mention this specific instance as one of many which occur in practice every day, and also to impress the fact that cultures are of little value in settling the diagnosis. Often too much time is lost as well as the life of the patient, when we delay from day to day by taking cultures rather than admitting the element of doubt and giving a dose of antitoxin.

The clinical picture of a case of trachea-bronchial diphtheria is quite distinctive of this disease. The onset is seldom sudden, and

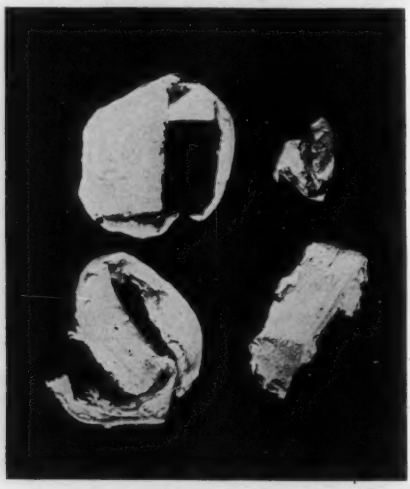

Fig. 4. Parietal tracheal and bronchial casts from case 8, top right hand corner; case 21, top left hand corner; case 33, bottom left hand corner; case 28, bottom right hand corner.

the voice is never lost, and aside from an occasional cough and slight stridor, the condition may be readily overlooked and treated as an ordinary catarrhal cold. An extremely sad example of this occurred in the family of a very reputable surgeon. The child was not at all sick and aside from a slight cough at times had no disturbance whatsoever. There was no rise in temperature, and the unfortunate little patient played with her toys, and was apparently as well and bright as the other children in the family. The father, who is a very close observer, did not consider the condition other than a catarrhal cold, which was only quite natural from the clinical picture. On the fifth day of the disease the stenotic symp-

toms became marked; the temperature rose to 103° F., accompanied by marked restlessness, cyanosis and irregular pulse; the respirations were labored and asthmatic in character, and there was marked sinking in of the supraclavicular and sternal notches, as well as dipping in of the epigastrium. It was very evident at this date that the condition was one of diphtheria, with which we had to deal. Intubations and antitoxin were of no avail and the child died within a few hours.

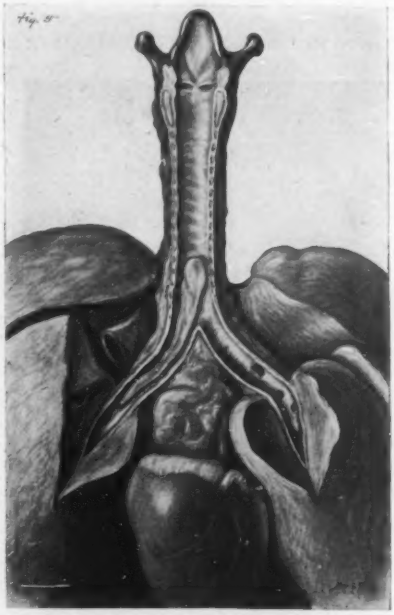

Fig. 5. Case 35. Showing membrane reformed in the left bronchus on account of it not having been removed entirely from the bronchial branches. There was no involvement of the larynx or upper trachea.

I can report a number of cases with similar histories which I think only goes to show how easily these conditions have been overlooked formerly, and there is no doubt that many are still overlooked, unless a cast of membrane is coughed up, or the larynx becomes involved with a typical picture of laryngeal "croup." It is only then that a correct diagnosis is made. There is no doubt that many of the so-called asthmatic attacks which terminate fatally, are due to diphtheritic bronchial obstruction.

When one is called to see one of these low membranous types of diphtheria, he will readily note the ballooning of the chest, for in these cases there will be marked emphysema of the lung in which the bronchus is obstructed. These foreign bodies seem to act as a valve, and air can enter the lung much more readily than it can make its exit, which accounts for the ballooning of the lung. The type of respiration is decidedly asthmatic, accompanied by early cyanosis and a cough which is seldom of the croupy type unless the larynx has become involved. I have frequently noted only one side of the chest barrel-shaped, and on passing the bronchoscope found only the bronchus on that side obstructed. The barrel chest is espe-

Fig. 6. Cylinder and ribbon cast removed from trachea and right bronchus, by bronchoscopy.

Fig. 7. Torn cylindrical cast removed. There was a ribbon cast which was coughed up prior to the removal of the second cast.

cially marked in young children. The respiratory murmur is diminished or absent on the affected side while over the healthy lung the respiratory murmur may be so harsh that it is mistaken for pure bronchial breathing. This is, therefore, another reason why a mistake in diagnosis is made, and the unaffected lung called pneumonic. Dullness is seldom present in these cases, and a hyper-resonant note is the rule, due to the enormous amount of emphysematous lung tissue. The alveoli may be markedly distended at times, and it is not at all uncommon at autopsy to find large air blebs covering the visceral pleurae and the outer surface of the pericardium. Even the pericardial sac may be ballooned with air. At times these blebs

rupture into the mediastinal spaces at the root of the lung, and the air following the deep cervical fascia gets into the subcutaneous cellular tissues and we have a generalized subcutaneous emphysema. Since the advent of direct laryngoscopy and bronchoscopy, many children with foreign body diphtheritic membrane plugging the bronchi have been saved and even those who have fatal termination are treated, however, on definite scientific principles. Any slowly progressive dyspnea should be looked upon with a considerable degree of apprehension and when we are unable to account for the cause of the dyspnea, a bronchoscopic examination should be made.

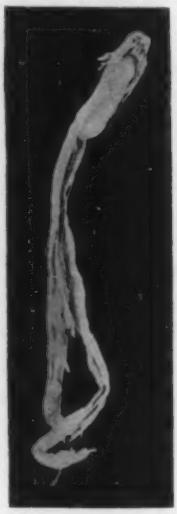

Fig. 8a. Torn cylinder cast coughed up by an adult 26 years of age.

There is little shock accompanying a bronchoscopic examination in these children. I have passed the bronchoscope on a number of cases of pneumonia without untoward effect on these subjects, but I do not profess to make any claim that bronchoscopy will have a beneficial effect in the treatment of pneumonia even if we use suction to remove the ropy mucus which often makes respiration difficult, for the fatal termination of a pneumonia is not due to mechanical obstruction to respiration, but to the failing action of the heart, caused by the profound pneumotoxemia. In tracheo-bronchial diphtheria the process is a mechanical obstruction to respiration plus carbonic acid poisoning and diphtheritic toxemia.

If the heart action is supported in these diphtheritic cases until the mechanical obstruction is removed the outcome of the case is usually favorable. Again, if respiration fail prior to the failing of the heart, the patient can be resuscitated, but if the heart failure precede the respiratory failure there is but little chance of resuscitation. This cardiac and respiratory mechanism I have studied very closely in all intubated cases, especially in the auto-extubation type. In these cases there is marked perichondritis of the cartilages of the larynx, which is the cause of the persistent coughing up of the tube, for the cricoid cartilage having sloughed out can no longer hold the tube in place. These cases give one but little time to deliberate, for the larynx collapses as soon as the tube is coughed out and if

Fig. 8b. Second cast removed twenty-four hours later which is filled with blood clot converting it into a solid cast.

no intubator is at hand the termination is usually fatal. Many times the child will be lost if one fights to get the tube introduced while the child is in the death spasm, and the easiest way to handle this condition is to let the patient practically die, and then by rapid intubation and artificial respiration the child will slowly return to life. In all of these cases the heart sounds will be heard with the stethoscope before respiration returns. When the heart sounds are inaudible there is little chance for resuscitation even though the child may inspire once or twice during the artificial manipulation. The identical is true of cardiac and respiratory failure in these diphtheritic bronchial stenoses. The only supportive treatment given, in fact, the only drugs used besides the antitoxin are small doses of morphia, atropia and adrenalin. All of the instrumentation is done without any anesthetic on children as well as adults.

The Physical Signs. The physical signs are of the greatest aid in arriving at a diagnosis. Inspection will invariably reveal a barrel-shaped chest referable to the side on which the bronchus is obstructed, and there will be noted even early in the disease retraction of the sternal notch and sinking in of the epigastrium. Cyanosis of the finger tips is an ever present sign.

Percussion. The signs of atelectasis which are found at autopsy, are usually masked by the surrounding areas of emphysematous lung tissue and there is increased resonance, hyper-resonance, over the entire collapsed area.

Fig. 9. Cast partially removed through tracheal fistula. The bronchial portion was coughed up and obstructed the tube and was later removed. Adult female, 22 years. Willard Parker Hospital. Died same day.

Auscultation. The most constant physical signs are, a diminished or absent respiratory murmur over the affected side, in comparison to the rather harsh respiratory murmur over the unaffected lung which may be so marked as to be mistaken for bronchial breathing. The rales are of the subcrepitant variety, but may also be sibilant and sonorous. When the patient has been intubated with an O'Dwyer tube which is not long enough to give relief, it is best to remove the tube before making a physical examination, for the amount of mucous transmission through the tube will magnify as well as distort all of the physical signs. One of the best and the most accurate auscultatory sign is elicited by placing the bell of the

stethoscope firmly on the trachea in the sternal notch with the head well retracted. At this site there are no transmitted rales, and one can often hear a "flip-flop" sound due to a loosened piece of membrane which is blocking respiration. With these physical signs which are fairly constant, accompanied by a peculiar inspiratory-expiratory asthmatic dyspnea I think are the chief indications for bronchoscopic measures.

The differential diagnosis is to be made from broncho-pneumonia, catarrhal bronchitis, foreign bodies and thymic asthma.

From *bronchopneumonia* by the absence of the constricted cough,

Fig. 10. Larynx and trachea removed at autopsy from a child 5 years of age in whom tracheal diphtheria was never suspected. There was no membrane in the bronchi.

the different character of the dyspnea, and the physical signs in the chest which differ from bronchial obstruction. The diminished or absent respiratory murmur with a hyper-resonant note over the lung in which there is bronchial obstruction, and the constant and progressive character of the asthmatic dyspnea, are the best guides in making a differential diagnosis. Again, failure to relieve the stenosis by the O'Dwyer tube and the peculiar constricted or rather blocked expiratory cough with the tube in place is indicative of membrane below the tube.

From *foreign bodies* of extremely irritating substances, such as peanut and carrot pulp, the character of the dyspnea and cough is

extremely violent and the patient may rapidly become exhausted from the prolonged respiratory effort. The cough reflex is lost in the later stages. The history of aspiration of the foreign body, and the suddenness and extreme severity of the attack are the best aids in arriving at a conclusion.

From *catarrhal bronchitis,* the diagnosis is at times extremely difficult for in many instances the clinical picture in diphtheritic obstruction is one of catarrhal bronchitis at the outset. The involvement in the severe form of bronchitis of the smaller tubes, as

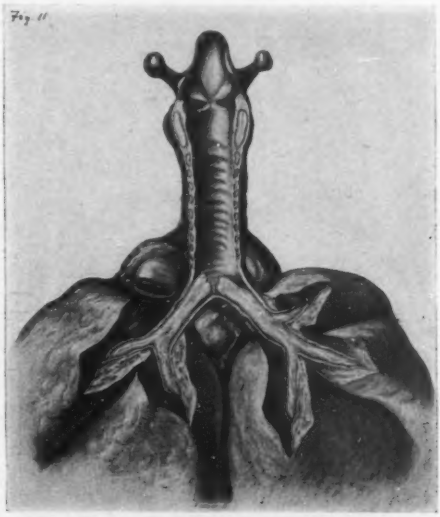

Fig. 11. A remarkable case diagnosed bilateral bronchopneumonia and never intubated. No suspicion of diphtheria as all of the pharyngeal cultures were negative, and the voice was not lost. The case was discovered during routine practice of measuring bronchi in the morgue.

seen particularly in measles, is usually bilateral, well marked from the onset, and there are the ever constant sibilant and sonorous rales, and the normal resonance on percussion. The attack is not slowly progressive, but well marked from the beginning. At times there may be marked cyanosis and dyspnea, especially in young children.

From *thymic asthma,* by the history of the constant attacks of asthmatic dyspnea, the peculiar conformation of the chest, and the x-ray findings. The treatment of this condition resolves itself into the treatment by intra-muscular and intravenous injections of anti-

toxin in large doses. I think intravenous injection is contra-indicated when the heart action is failing and I have seen fatal results rapidly follow flooding of the circulation by intravenous injection. I have seen several cases of tracheal diphtheria in private practice which were recognized early in the disease all of whom recovered after a dose of 10,000 units of antitoxin subcutaneously. All of these children had parietal casts and intubation was not necessary. There is little or no prostration early in the disease, and post-diphtheritic paralysis is never seen, unless the case is of long

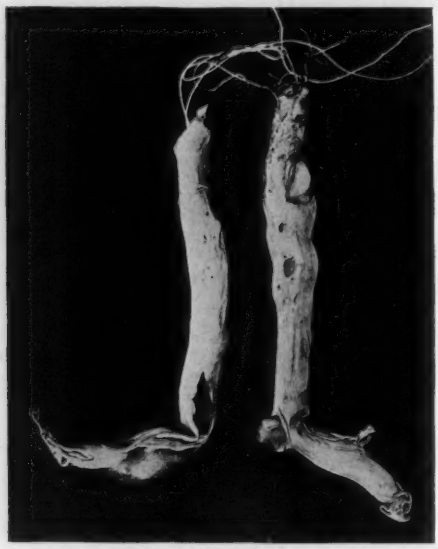

Fig. 12. Two remarkable casts coughed up by a man 87 years of age, admitted to the Willard Parker Hospital.

standing and the pharynx and tonsils have become involved. Even enormous dosage of antitoxin and mechanical removal of the membrane in the case of long standing is futile, for these patients invariably succumb.

Mechanical removal of the obstructing membrane through the direct laryngeal speculum and bronchoscope is not at all difficult if the case is recognized fairly early, even before antitoxin is given, and is followed by only a small amount of bleeding in comparison, to the rather free hemorrhage when membrane is stripped from the tonsils or pharynx. Formerly I used both forceps and suction

but the forceps are of little use as they only remove small pieces of the membrane and naturally prolong the operation. With the small suction tube attached to the small spray and vacuum pump made by Sorensen, of New York City, the membrane is readily removed in long pieces and the bronchoscopic manipulation materially shortened. Made and broken suction with a Potain aspirator is also useful, but is never as satisfactory as the continuous vacuum made by the electric motor. A vacuum of five inches is sufficient to remove all of the membrane and causes little bleeding

Fig. 13. A case of primary laryngeal diphtheria admitted in extremis to the Kingston Avenue Hospital. No attempt was made to intubate, and a rapid tracheotomy was performed by Dr. Harold Steele. The man succumbed the following day. No membrane on tonsils and no extension into trachea; ill three days.

while an increased vacuum of from fifteen to twenty inches will not only cause considerable bleeding but will nipple the bronchial wall wherever it comes in contact with it by causing too much suction on the mucous membrane.

After the foreign body membrane has been removed the whole of the tracheo-bronchi are sprayed or swabbed by antitoxin locally, followed by intubation with long tracheo-bronchial tubes. These long tubes are introduced with an endeavor to prevent recurrence of the stenosis should the membrane reform, for the membrane in spreading may form about a blood clot and we have as a result a solid cast; whereas with a tube in place the membrane may form

about the tube leaving an open lumen for respiration. I have a specimen removed from an adult at autopsy which was a second cast, the first, a torn cylinder cast, having been coughed up; the second cast was a complete cylinder on the outside, the lumen of which was filled with blood, converting it into a solid cast. The local medication with antitoxin is to prevent the recurrence of the membrane as well as to prevent hemorrhage.

The relief of these tracheal and bronchial stenoses by bronchoscopy is equally as gratifying in results as the relief of the diphtheritic laryngeal stenosis by the intubation tube of Dr. O'Dwyer.

The duration of bronchoscopy for the removal of the membrane should always be considered, and all bronchoscopists will do well to follow the dictum of Dr. Chevalier Jackson and have some assistant time them at each bronchoscopic examination in order to avoid its unnecessary prolongation, especially in young children. Adults even without cocain anesthesia complain very little and suffer from no apparent shock when the removal of the membrane has taken from thirty minutes to one hour, and as long as the tube is in, separating the edematous mucosa, they breathe with apparent comfort. In children I always leave the bronchoscopic tube in the bronchus from which the membrane has been removed for a period of from fifteen to thirty minutes after spraying with antitoxin, and in many instances the little patients will fall asleep on the table after the respiratory exhaustion has been relieved and they are able to get free passage of air.

Tracheotomy: I have gone on record more than once in saying that I have yet to see a case of laryngeal diphtheria relieved by tracheotomy in which an O'Dwyer intubation tube failed to relieve the condition. Nor have I ever seen a case of tracheo-bronchial diphtheria relieved by tracheotomy when the tube of Dr. O'Dwyer was not long enough to reach below the obstruction. During my early days at the Willard Parker Hospital many tracheotomies were performed for the relief of membrane below the O'Dwyer tube, but the results were signal failures with 100 per cent mortality to my credit, and even with tracheotomic-bronchoscopy the results were equally as bad. In one adult three distinct casts were removed through the tracheal fistula within a period of forty-eight hours, and with the removal of the last cast a well organized blood clot asphyxiated the patient within a few minutes. Since peroral bronchoscopy has been practiced and forceps discarded for suction tubes, the mortality has been markedly reduced during the past few years, and I am able to report at the present time a recovery

rate of 64.6 per cent inclusive of cases which have died within twenty-four or forty-eight hours after admission to the hospital.

As the great majority of these cases are intubated with long tubes after the removal of the foreign body membrane there is never any anxiety on the part of the house staff that tracheotomy will be necessary from subglottic edema even if it has been necessary to prolong the bronchoscopic examination. These tubes are usually removed within the first seventy-two hours, and reintubation with the long tubes has never been necessary. In one or two cases reintubation was necessary with the O'Dwyer tube on account of marked infiltration of the arytenoid cartilages. When these cartilages are infiltrated the cords fail to abduct and intubation is always necessary to separate the cords which cannot pull apart and give free passage of air. It is well to study the condition of the arytenoids by direct laryngoscopy before any intubation tube is removed, and if the arytenoid cartilages are still swollen it is best to wait until this condition has subsided or else the child will not remain without the tube. Failure of a patient to remain without the tube during the first two weeks in the acute diphtheritic lesion of the larynx has always been said to be due to adductor spasm and subglottic edema, but one of the real causes is a pseudospasm of the adductors from failure of the markedly infiltrated arytenoid cartilages to separate in abduction.

The writer has been able to demonstrate at autopsy that many of these membranes may be confined to one bronchus, and he thinks the other bronchus may become involved by pieces of membrane and organisms being coughed up to the bifurcation and aspirated into the other bronchus. This may in a measure account for the insidious onset of the disease, and the gradual extension of the membrane in causing complete obstruction to respiration. The following cases all had membrane in the trachea and bronchi, and none were included in this classification in whom the primary intubation with an O'Dwyer tube relieved the obstruction. The tonsils, pharynx and nares were taken into careful consideration as well as the condition of the larynx.

CASE REPORTS OF TRACHEO-BRONCHIAL DIPHTHERIA.

Case 1. **Dorothy S. Age, 5 years; ill four days; admitted to the Willard Parker Hospital January 10, 1913, suffering with laryngeal diphtheria. Intubation was performed with a 4-5 O'Dwyer tube. There was exudate on the tonsils, laryngo-pharynx and larynx when viewed by the direct speculum. The child was markedly cyanotic before the intubation and little air was entering either lung. The heart-sounds were markedly irregular and the respirations labored. The intubation tube gave little**

relief and the cyanosis was not improved. Physical examination with the tube in the larynx showed that there was still considerable obstruction to respiration. On listening over the sternal notch, a loose piece of membrane could be detected obstructing expiration. When the intubation tube was removed to permit bronchoscopic examination, a tracheal cylindrical cast was coughed out, accompanied by considerable bleeding. The trachea was swabbed with antitoxin and a long tracheal intubation tube introduced. No further instrumentation was made. The coughing out of the cast and the long tube relieved the condition, and the child fell asleep. The temperature on admission was 103° F.; pulse, 140; respiration, 40. Cultures positive. A dose of 30,000 units of antitoxin was administered by intra-muscular injection. The tube was removed at the end of 72 hours, and it was not necessary to reintubate. There was no complications. The child made a perfect recovery and was discharged from the hospital January 31, 1913.

Case 2. Ruth H. Age 3 years; ill three days; was admitted to the Willard Parker Hospital, March 4, 1913. The child was *in extremis* on admission. There was no visible exudate on the tonsils, but there was a slight amount of membrane in the laryngo-pharynx. The larynx was almost completely covered with exudate, the vocal cords were not visible, the arytenoids enormously swollen. Intubation was performed with a three-year tube, which gave no immediate relief. It was removed but no membrane was coughed up. Owing to the poor condition of the patient no further attempt was made to remove the membrane, for the long tube had passed beyond the site of the obstruction. The child was able to breathe much better, the blocked expiratory cough had disappeared and the respiratory effort was less marked. A dose of 25,000 units of antitoxin was given.

Owing to marked infiltration and ulceration of the arytenoid cartilages the tube was not removed until March 9, the fifth day after admission. The child did well and remained without the tube for six days when, owing to gradual sub-glottic contraction, it was necessary to reintubate. Ten days later the tube was again removed and at the end of twelve days reintubation was necessary. At each trial the interval without the tube was prolonged but the persistent contraction would necessitate reintubation. In the early part of April the unfortunate little child developed a severe attack of measles complicated with broncho-pneumonia, and succumbed to the disease one week later. The tube was worn up to the time of her death. While there had been a good result in the relief of the primary diphtheritic stenosis of the larynx and trachea, the productive inflammation was of sufficient degree to cause sub-acute retention of the tube, and had she lived she would have undoubtedly become a chronic retained tube case.

Case 2.* M. C. A male child of eight years, seen in consultation with Dr. Eversfield, March 8, 1913. The boy had not complained of sore throat, nor was there any nasal discharge and aside from the cough, which was not distressing, there were no signs to indicate tracheal or laryngeal obstruction. The voice was hoarse but not entirely lost. On the day of consultation, the third day of the illness, the stenotic symptoms became marked. The temperature which had been 100° rose rapidly to

103° F.; pulse, 138 and irregular; respiration, 40 and labored. There was marked retraction. The child was markedly cyanosed and there was little air entering either lung. Intubation was performed by the method of Dr. O'Dwyer with an 8-9 tube which gave but little relief, for it was very evident that there was membrane below the tube on account of the peculiar obstructed expiratory sound. A direct examination was made after the tube was removed. There was no visible exudate on the tonsils, laryngo-pharynx or larynx. There was slight infiltration of the arytenoids; the vocal cords were congested. There was a piece of membrane partially detached which on expiration would be plainly visible at the cricoid level, only to disappear on inspiration. This piece of membrane was seized by the forceps and removed, the larynx and trachea were swabbed with antitoxin and the tube reintroduced. As the removal of the membrane seemed to relieve the stenosis, bronchoscopy was not performed. A dose of 30,000 units of antitoxin was administered. The tube was removed on the third day and a perfect recovery followed. Cultures taken direct by the swab method were positive.

Case 3. S. D., five and one-half years of age seen with Dr. Eversfield, March 9, 1913. The child had just recovered from an attack of scarlet fever and had been discharged from quarantine the week previously. The child was *in extremis* when I arrived at the house and was immediately intubated by the O'Dwyer method and removed to the hospital. There was slight exudate on the tonsils, the epiglottis infiltrated and the arytenoid cartilages swollen. The tube became blocked shortly after admission to the hospital and was removed, followed by a piece of membrane. The child did well for a few minutes when he became stenotic and reintubation was necessary, a longer tube being used. This tube also became blocked shortly after introduction and was removed, followed by a long, ribbon-like piece of membrane and some bleeding. The long intubation tube was reintroduced. The condition of the child improved after the coughing out of the membrane, and the cyanosis and retraction which were marked almost entirely disappeared. The temperature was 101°; pulse 156; respiration, 44. A dose of 30,000 units of antitoxin was given. On March 10, the child was in fairly good condition but cyanosis was still present as well as a small area of patchy pneumonia over the upper lobe of the right lung. On the following day the general condition of the patient had markedly improved. There had been some local reaction to the antitoxin. On March 13, the fourth day after admission to the hospital, the tube was removed. There were some spells of dyspnea following its removal but it was not necessary to reintubate. The questionable area of pneumonia resolved with the removal of the tube, and the patient made a perfect recovery. The cultures from the throat and casts were all positive. The child was discharged March 31, 1913.

Case 4. D. K., a child of eighteen months, seen with Dr. Van Zile, in Brooklyn, January 18, 1913. The history given by the parents as well as by the physician was that the child had been suffering with an ordinary catarrhal cold and bronchitis and aside from the occasional cough and slight wheezing, little attention was paid to the condition until the sixth day, when the symptoms of laryngeal stenosis became alarming. According to Dr. Van Zile, he had made a diagnosis of catarrhal bronchitis from the clinical picture and the physical signs in the chest. The pharynx

was examined and no evidence was present of any local lesion. In fact, diphtheria was not suspected until the evening of the fifth day when a follicular exudate on the left tonsil was seen. A culture was taken and a dose of 10,000 units of antitoxin was given. The temperature, which had been between 98.4° and 100°, rose rapidly to 104.2° F.; pulse, 156; respiration, 54, and labored. A few hours later the stenotic symptoms became so marked and the child so restless and cyanotic that Dr. C. S. Hudson was called to see the case and he pronounced it to be tracheal and bronchial diphtheria. Intubation was performed but it gave no relief and I was called to make a bronchoscopic examination of the child. Little air entered either lung even with the short intubation tube in place. The heart action was irregular. By direct examination a fairly well defined exudate on the left tonsil was seen; the right tonsil was free of membrane. There was also a thin exudate on the laryngo-pharynx; the larynx was covered with a thick membrane from the tip of the epiglottis covering the inferior surface and the ventricular bands and vocal cords. The arytenoid cartilages were enormously swollen and covered with patchy areas of membrane. It was very evident that little could be done to relieve this amount of mechanical obstruction to respiration, and furthermore, the profound diphtheritic toxemia of such duration made the outlook rather hopeless. The small bronchoscope was introduced and as it entered the trachea it passed into a cylindrical cast of membrane. The suction tube was attached and some small pieces of membrane were removed. This seemed to give a little relief. There was not sufficient expiratory cough to be of any aid in dislodging the membrane. The bronchoscope was left in for two hours and suction was used from time to time with the removal of a small piece of membrane. Further examination of the tracheo-bronchial tree showed that the membrane involved all of the bronchi. The bronchoscope was removed and a long 7 cm. intubation tube introduced. A dose of 30,000 units of antitoxin was administered intramuscularly. The condition of the child gradually became worse, and she died the following day. The parents granted permission for a necropsy.

The lungs were enormously increased in volume with emphysematous blebs over the visceral pleurae. On section they dripped blood and were enormously congested. The section would float on water. The larynx was covered with a thick membrane which was extremely adherent; the trachea, both main bronchi and their branches were filled with a cylindrical cast. The fine bronchi and bronchioles were also occluded. The lung, on microscopical section, showed the alveoli filled with plasma cells and lymphocytes. While there were many leucocytes and multinucleated leucocytes, the great proportion were of lymphocytic origin, and the pneumonia was of a different type than the ordinary types of pneumonia as seen by biopsy. The alveolar wall was thickened and the cellular structures showed areas of coagulation necrosis which took the stain poorly; many diphtheria bacilli were seen in the meshes of the fibrin coagulum in the alveolus. Cultures taken from these areas were practically pure cultures of diphtheria bacilli.

A section through the right main bronchus just at the bifurcation showed a zone of coagulation necrosis deep into the mucosa, while the bronchial lumen was covered with a fibrinous diphtheritic deposit which

took the stain poorly. The infiltration extended into the sub-mucosa, at which site there was an enormous proliferation of small round cells. There were a few areas of rather deep necrosis in the sub-mucosa which took the stain poorly. The cartilage of the bronchi was not involved.

This case demonstrates rather forcibly the massive involvement of the tracheo-bronchial tree by diphtheritic membrane, and even if all of the mechanical obstruction had been removed, the diphtheritic pneumonia and toxemia could not have been combated in time to save the life of the child. This case, I think, was unquestionably one of the types with the infection starting primarily in the bronchus and traveling upward, which accounted for the peculiar physical signs simulating bronchitis and the slow but progressive development of the disease in causing complete obstruction to respiration.

Case 5. J. B., a boy of 7 years, was seen in consultation with Dr. Marxuach, January 24, 1913. The child had been ill for three days and had progressive asthmatic attacks during this period until the symptoms became more marked and the dyspnea urgent. There had been sufficient air entering the lungs up to this time but at the time I saw the case there was little air entering either lung and the child was markedly cyanotic. There was marked retraction accompanied by the usual irregular action of the heart and aspirated pulse. A rapid direct examination showed the larynx to be free from membrane. There was no visible membrane on the tonsils or pharynx. While the voice was not lost, the vocal cords were congested. Intubation was performed with a 6-7 O'Dwyer tube, which did not give relief and the cyanosis, dyspnea and restlessness became marked. The tube was removed and the tracheoscope introduced which revealed a cast of membrane on the antero-lateral tracheal wall opposite the sternal notch. This plaque was partially removed, the trachea swabbed with antitoxin and a long tracheal intubation tube introduced. The long tube caused considerable irritation and coughing but after a short time gave the desired relief. A dose of 20,000 units of antitoxin was administered. The tube was removed on the third day and the boy made a perfect recovery. Cultures made by direct swab method were positive.

Case 6. M. W., a woman of 24 years, ill three days, was admitted to the Kingston Avenue Hospital, January 22, 1913, suffering from laryngeal diphtheria, not intubated. The condition of the patient became gradually worse and Dr. W. T. Cannon, the resident physician, intubated the woman with a small adult tube about the length of a 10–12 intubation tube. The tube did not relieve the stenosis. Because of the blocked cough, rasping respiratory effort and cyanosis, the tube was removed and the patient seemed to breathe much better without the tube, but within half an hour again became stenotic. Dr. Cannon again intubated the woman with a longer tube and when this tube failed to relieve the obstruction, notified me of the condition. While I was on my way to the hospital, Dr. Cannon kept on trying longer and longer tubes and finally a cylindrical cast of the trachea with a branch of one of the main bronchi was coughed out, which relieved the condition. The long tube was reintroduced and removed 48 hours later. The patient was able to remain without the tube and made a perfect recovery. No further instrumentation was made by

me. The voice of the woman had not been lost prior to the intubation, but it remained rather husky for six days after the final removal of the tube, when it gradually returned to normal. A dose of 30,000 units of antitoxin was given. The cultures taken by the swab method from the pharynx were all negative, while those made from the cast which was coughed out showed diphtheria bacilli. There was no exudate on the tonsils and no complications. The patient was discharged February 18, 1913.

Case 7. C. N., a man of 30 years, ill five days, was seen with Dr. Austin W. Hollis, October 24, 1912. The history was that the man had been suffering with a bad cold and bronchitis for three days with rapidly progressive attacks of dyspnea. There had been no membrane on the tonsils but on account of the progressive dyspnea and peculiar physical signs in the chest, Dr. Hollis suspected diphtheria in spite of negative cultures and gave a large dose of antitoxin. The condition apparently improved during the next twenty-four hours but became markedly worse after midnight, when I was called to see the case. The patient was *in extremis;* little air entered either lung and because of the mucous rales and clicks, accompanied by the rasping inspiratory-expiratory dyspnea, the physical examination was of little use. There was marked cyanosis and a full, rapid pulse, which would not altogether disappear with the effort at inspiration. Owing to the fixed position of the chest wall, the retraction was not marked. There was dipping, however, of the supra-clavicular and sternal notches. The kidneys had become blocked and no urine had been passed for six hours. Treatment of this condition had given no response. As the man was in desperate condition, no attempt at direct examination was made, nor was intubation attempted. A rapid tracheotomy was performed, but this was exceedingly difficult on account of the short, thick neck of the patient. On opening the trachea, a piece of membrane was coughed through the wound, followed by a sharp hemorrhage. The tracheal wall was enormously infiltrated and was apparently about three times its normal thickness, which was noted after the hemorrhage had ceased. A long tracheal canula was introduced. The patient continued to grow worse and died at 8 a. m. A post-mortem examination of the trachea showed the whole laryngo-tracheo-bronchial tree to be filled by a cylindrical cast of false membrane, and the region of the tracheotomy fistula at which site the cast was removed to be very edematous. There was membrane on both tonsils.

Case 8. C. B., a boy 8 years of age, was admitted to the Kingston Avenue Hospital, February 12, 1913. The case was sent in to the hospital for immediate intubation but this was not necessary for there were no signs of laryngeal stenosis. The tonsils and pharynx were free from exudate and there was no nasal discharge. The temperature was 101.2° F.; pulse, 122; respiration, 36. A physical examination of the chest revealed a slightly diminished respiratory murmur over the right bronchus and scattered sub-crepitant rales over the same area. The action of the heart was rapid but regular. A direct laryngeal examination showed the larynx to be normal. No bronchoscopic examination was made because neither Dr. Dickson nor I suspected tracheo-bronchial diphtheria. We felt quite sure that the trouble was due to a central pneumonia. According

to the history, the patient had been ill two days and a dose of 10,000 units of antitoxin had been given prior to admission. With our picture of a central pneumonia, no further antitoxin was considered necessary. On February 16, the fourth day since admission to the hospital, the boy had a violent fit of coughing and a cylindrical cast with a few small, stringy pieces attached to the lower end, which may have been branches from a bronchus or, as I thought, was a portion which had undergone partial exfoliation and the ends were only torn pieces of the same cast, was coughed out. The temperature had been running a remittent type up to this time and with the pulse rate rapidly falling and the patient rather dull, Dr. Steel suspected typhoid fever with the onset of pneumonia, but the cast which was coughed out cleared up the diagnosis. On the following day the temperature had fallen to normal, and from this date the boy had no further discomfort and made a rapid recovery. There were no complications aside from the diphtheritic pneumonia. The patient was discharged March 1, 1913. Cultures taken by the swab method were negative.

Case 9. D. Z., a child of 2 years, ill five days, seen with Dr. Emanuel Marxuach, February 14, 1913. The child had been ill for five days before a physician was called. The parents did not consider the condition of the child dangerous, nor was the cough looked upon with any degree of apprehension until the morning of the fifth day when the symptoms became alarming. On arrival at the house I found the child *in extremis*, markedly cyanotic, and with labored asthmatic dyspnea. Intubation was performed by the O'Dwyer method with a two-year rubber tube, which gave temporary relief but soon became blocked and was removed. A rapid direct laryngeal examination was made and the small bronchoscope passed through the larynx, which was partially covered with membrane. The bronchoscope became obstructed with membrane as soon as it was passed and on removal a long piece of membrane followed. With the removal of this piece of membrane the condition of the child slightly improved. The bronchoscope was reintroduced and as this time it did not become obstructed, it was left in place for one hour. In the meantime, a dose of 30,000 units of antitoxin was administered intramuscularly. The parents were induced to allow the child to be taken to the hospital. The bronchoscope was removed and a 7 cm. intubation tube introduced. On arrival at the hospital, further attempt was made to remove the membrane by suction through the bronchoscope for the parents would not give permission for low tracheotomy. Through the bronchoscope it could be plainly seen that both main bronchi were occluded by membranous casts, a portion of which was removed by suction; but the bronchi could not be cleared of membrane so the bronchoscope was removed and the long intubation tube introduced. With the tube in place little air was entering either lung. The temperature was 104.2° F.; pulse under stimulation was difficult to count and the respirations were labored and rasping, with all of the accessory muscles brought into play and marked dipping of the epigastrium. The condition continued to grow worse and the child died at 8 a. m. the following morning.

Case 10. N. G., a boy 9 years and 9 months old, was admitted to the Kingston Avenue Hospital, June 12, 1913. There was no visible exudate

on the tonsils nor was there any nasal discharge. The boy had been ill two days prior to admission and had received a dose of 10,000 units of antitoxin. Owing to the peculiar character of the dyspnea a second dose of 10,000 units of antitoxin was administered. On admission, the voice was not lost, but the dyspnea was marked at times. The temperature was 100° F.; pulse, 122; respirations, 32; retraction, while present, was not marked. Direct examination showed the larynx free from exudate. There was no infiltration of the arytenoid cartilages; the cords were slightly congested. There was some sub-glottic infiltration but not of sufficient degree to cause obstruction. A tracheoscope was passed and a small patch of membrane seen on the lateral tracheal wall with the surrounding tissue swollen up to the region of the cricoid cartilage. There was no membrane below this area. Antitoxin was applied locally to this portion of the trachea by a cotton swab on a Coolidge applicator and the small piece of membrane removed at the same time. Intubation was not necessary. The next day the dyspnea had improved and by the third day all evidence of dyspnea had disappeared. A very bothersome antitoxin rash of the urticarial type developed on the sixth day after admission, accompanied by marked edema. There was slight dyspnea while the rash persisted. The urine was negative to albumen but loaded with indican. By the end of a week the rash which had been recurrent had practically disappeared and the patient was discharged ten days later. There were no complications and all of the cultures were negative.

Case 11. D. H., age 6 years, ill two days, was admitted to the Kingston Avenue Hospital, January 27, 1914, for laryngeal diphtheria. The child was not intubated on admission, and even though there was marked retraction at times, the voice was not lost. The child had been ill two days prior to admission and had received a dose of 20,000 units of antitoxin. There was no nasal discharge nor was there any exudate on the tonsils or pharynx. The larynx was slightly congested; the cords practically normal. A small parietal plaque of membrane which could be plainly seen on the anterior wall of the trachea. This area was swabbed with antitoxin and the small piece of membrane removed. Intubation was not necessary. The temperature on admission was 100.2°; pulse, 138; respiration, 33. A sufficient quantity of air was entering both lungs. The child made an uneventful recovery and was discharged from the hospital February 24, 1914. The heart-sounds were irregular for two weeks and the cultures taken by the Coolidge swab were positive.

Case 12. F. R., age 4 years, ill four days, was admitted to the Kingston Avenue Hospital, February 2, 1914, for laryngeal diphtheria. There was slight exudate on the right tonsil, no nasal discharge and no cervical adenitis. The temperature was 101.6° F.; pulse, 152; respiration, 32, and labored. Little air was entering either lung and there was cyanosis of the extremities. The action of the heart was rapid with an aspirated pulse with each inspiration. By direct laryngeal examination a thin exudate about the size of a match-head was seen on the left arytenoid cartilage. No membrane was present on the ventricular bands or vocal cords, but the cords were congested. There was an area below the cords which was infiltrated and covered with a pearly white membrane. The area was swabbed with antitoxin and a cast about one inch in length

was coughed out on removal of the swab. The direct examination caused no marked discomfort and the relief of the stenosis was very evident with the removal of the cast. However, intubation was necessary six hours later, a 4-5 O'Dwyer tube being used which gave immediate relief, the intubation being probably caused by sub-glottic infiltration due partially to the mechanical removal of the membrane. Twenty thousand units of antitoxin were given intramuscularly several hours previously, but this failed to prevent intubation. The tube remained in for five days on account of the enormous infiltration of the arytenoid cartilages. Several slight stenotic attacks occurred after the removal of the tube but reintubation was not necessary. An urticarial antitoxin rash developed on February 20 and lasted for three days. The voice gradually returned and was normal on the eighteenth day. The patient was discharged March 10, 1914. All of the cultures were negative.

Case 13. T. G., a female child 6½ years old, was admitted to the Kingston Avenue Hospital, February 9, 1914, suffering with laryngeal diphtheria. The patent had been ill seven days. On admission the child was in poor condition, cyanotic and the pulse weak and rapid. There was exudate on the tonsils, uvula and pharyngeal wall. On physical examination of the chest little air was entering the right lung in comparison to the amount of air entering the left lung; there was no flopping sound heard at the sternal notch; the action of the heart was rapid and irregular. The child was intubated with a 4-5 tube which gave some relief but from the peculiar rasping and blocking of the expiratory effort the tube was removed and a longer tube introduced which became obstructed shortly after introduction and on removal was followed by a cast of membrane. The same tube was re-introduced. A dose of 30,000 units of antitoxin was administered. I saw the child with Dr. Cannon, the resident physician, the next day and as the tube introduced by him had given the relief desired, no further instrumentation was necessary. The tube was removed on the fourth day, but intubation was necessary twenty minutes later. It was noted by direct examination that the arytenoid cartilages were infiltrated and no attempt was made to remove the tube until this infiltration had subsided, which was ten days later, when the child was able to dispense with the tube. On this date the temperature, which had been running a remittent type, had reached normal. There were scattered sub-crepitant rales throughout the chest and the heart-sounds were of poor quality. On February 25, two days after the tube had been removed, a severe urticarial antitoxin rash made its appearance, accompanied by marked edema of the face and extremities. With the appearance of the rash, slow, progressive dyspnea developed and intubation was necessary. The larynx was so edematous that a three-year tube was introduced with difficulty. The tube was auto-extubated two days later and even though there were "croupy spells" for the next twenty-four hours, reintubation was not necessary. On March 2, the general condition of the child had slightly improved but convalescence was slow. The cardiac condition, though improving, was far from normal and the first sound and the second pulmonic sound were very weak. There were no paralyses. The child was allowed up on March 15, and was discharged from the hospital March 21, 1914. All of the cultures were negative.

Case 14. C. M., a boy of 4 years, ill seven days, was admitted to the Kingston Avenue Hospital, February 10, 1914, suffering with laryngeal diphtheria. One thousand units of antitoxin was given before admission and 30,000 units on admission. The temperature was 99; pulse, 118; respirations, 26. There was moderate retraction and cyanosis and the pulse was irregular. Exudate on both tonsils, with ulcerated areas on the pharynx were present. The larynx was covered with membrane; the cords were not visible, the arytenoid cartilages were enormously swollen. While swabbing the larynx with antitoxin a cast of the trachea with a branched bronchus was coughed out, probably from the right main branch, for by auscultation little air was entering the right lung. Intubation with long tubes made respiration much more difficult; without the tube the boy did fairly well. On February 13, several small pieces of membrane were coughed up; the cough was frequent, troublesome and "croupy" at times. There were scattered sub-crepitant rales throughout the right lung. The muscular sounds of the heart were fairly good and the rhythm was regular. On February 18, the general condition of the patient had improved. On February 21, slight post-palatine paralysis developed, the right levator being involved. There was no difficulty in taking food but there was a peculiar nasal twang to the voice. Aside from the slight palatine involvement, the condition of the child was very good on this date. On February 26, the action of the heart was very irregular but the palatine paralysis had not increased. These conditions gradually improved and the patient was discharged from the hospital one month later. All of the cultures were positive.

Case 15. Sadie P., 4½ years of age, was admitted to the Kingston Avenue Hospital, February 18, 1914, suffering with tracheo-bronchial diphtheria. The patient had been ill three days. A dose of 8,000 units of antitoxin was administered before admission. There was no clinical evidence of membrane on the tonsils, and no nasal discharge. Intubation was performed prior to admission by one of the house staff, but the tube was removed, as it gave no relief and even made respiration more difficult. To direct vision the larynx was practically normal. There was no membrane on the arytenoids, ventricular bands or vocal cords. The voice was not lost, and from the marked retraction, cyanosis and general condition of the patient together with the asthmatic dyspnea and physical signs in the chest pointing to bronchial obstruction there was no great difficulty in arriving at the diagnosis. A well-defined area of diminished respiratory murmur over the right lung with a hyper-resonant note, was present, in comparison to the normal note and exaggerated respiration over the left lung. The temperature on admission was 99° F.; pulse, 140; respirations, 44. A dose of 20,000 units of antitoxin was given after admission. The child was bronchoscoped and with suction a ribbon and cylinder-like cast which was seen to extend upward beyond the bifurcation into the trachea was removed from the right bronchus. A long intubation tube was passed into the right bronchus and the bronchus was medicated with antitoxin. The heart was supported by a small dose of morphia. The child was very restless after the manipulation, and from the physical signs the removal of the cast had not improved respiration. On the following day the temperature had risen to 104.2° F. There was marked

cyanosis, extreme restlessness and the pulse was almost imperceptible. As the retraction was marked, the tube was removed and was found plugged with a curdled mass. This was removed and the tube replaced. A well-defined area of consolidation was present over the right upper lobe. The respiration was bronchial. It was unquestionably a diphtheritic pneumonia. The intubation tube was removed on February 25, and the unfortunate little patient remained without the tube up to the time of her death, March 1, 1914. The necropsy showed a markedly infiltrated right tracheo-bronchial tree. There was no membrane in the right bronchus or superior lobe bronchus. The whole of the upper lobe of the right lung was congested and the fine bronchioles plugged with thick, tenacious mucus. Areas of atelectasis with emphysematous patches were scattered about the periphery; the middle and inferior lobes were increased in volume. Cultures taken from the pneumonic process showed diphtheria bacilli. The primary direct culture was also positive. The temperature rose to 106° F. just prior to death.

Case 16. Sylvia S., 6 years of age, ill three days, was admitted to the Kingston Avenue Hospital, February 18, 1914, suffering with low membranous diphtheria. A dose of 20,000 units of antitoxin had been administered before admission, and 20,000 units were given on admission, both injections being given sub-cutaneously. There was no visible exudate on the tonsils, no discharge from the nose and no cervical lymphatic enlargement. The voice was not lost. There was marked retraction and the pulse was aspirated. The cough was very bothersome and stenotic and little air was entering either lung. The heart action was rapid and the first sound would almost disappear with each inspiration. The condition gradually became worse and intubation was necessary four hours later. The temperature was 101.4°; pulse, 146; respirations, 38. The intubation with a 6-7 O'Dwyer tube failed to give the desired relief and even with the tube in the larynx, little air was heard entering the lungs. The tube was removed and a longer tube introduced by the direct method. This relieved the stenosis and the child fell asleep shortly afterwards. No membrane was visible in the larynx and the vocal cords were normal. No bronchoscopic examination was made for the long tube had relieved the dyspnea. The tube was removed on the fourth day and the child remained without the tube ever since. There were many scattered rales and transmitted sounds throughout both lungs after the relief of the obstruction by the long tube, but there were no definite pneumonic areas and the rales disappeared with the removal of the tube. The voice, which had not been affected prior to the intubation, was completely lost after the removal of the tube but returned to normal one week later. The cultures taken from the pharynx, as well as the cultures taken from secretion coughed through the intubation tube were negative. However, the cultures showed positive results on March 18, when secondary cultures were taken before the release from quarantine. For a period of ten days these cultures were returned with positive and negative findings and finally after two consecutive negative cultures the patient was discharged on March 31, 1914.

Case 17, J. D., a boy 4 years and 9 months of age, ill three days, was admitted to the Kingston Avenue Hospital, February 23, 1914, suffering

with tracheal diphtheria. The child was intubated with a 4-5 O'Dwyer tube after admission. The tube gave no relief and was removed and the child breathed much better without the tube. There was no visible membrane on the tonsils or pharynx, nor was there any involvement of the nose. A dose of 30,000 units of antitoxin was given. At the end of two hours the dyspnea became so urgent that intubation was again necessary. For the second time the short tube failed to relieve the stenosis and expiration was blocked. It was very evident that the tube failed to pass the obstruction. The tube was removed and a direct laryngeal and bronchoscopic examination made. The larynx was free from exudate, the ventricular bands and vocal cords practically normal. The bronchoscope was passed and a parietal plaque was seen on the right lateral tracheal wall. There was no membrane in either bronchus. Through the bronchoscopic tube respiration was normal over both lungs. No attempt was made to remove the small piece of membrane, but the area was swabbed with antitoxin and a long tracheal intubation tube introduced. The tube was auto-extubated at the end of forty-two hours and the child remained without the tube. Slight dyspneic attacks occurred for the first twenty-four hours after the tube was coughed up, but reintubation was not necessary. The voice was not lost prior to the intubation but was moderately hoarse after the removal of the tube, which lasted for three days. All of the cultures taken were negative. There were no complications and the patient was discharged March 21, 1914.

Case 18. Lilly R., 6½ years of age, ill three days, was admitted to the Kingston Avenue Hospital, March 14, 1914. She was intubated for laryngeal diphtheria by one of the house staff before admission with a 6-7 O'Dwyer tube, but this gave but little relief and the dyspnea and cyanosis still persisted in spite of the intubation. There was no exudate on the tonsils, nor was there any nasal discharge. No antitoxin was administered prior to admission, but a dose of 20,000 units was given intravenously on admission. Temperature, 102.4° F.; pulse, 130; respirations, 32. On examination of the chest with the tube in place, air was entering both lungs but inspiration was prolonged and expiration shortened. There was much more difficulty with expiration than with inspiration.

The expiratory cough was blocked. The intubation tube was removed through the direct speculum and the larynx was seen to be free from exudate and there was but slight infiltration of the arytenoid cartilages caused by the wearing of the intubation tube for a few hours. On passing the bronchoscope, a loose piece of membrane was seen in the trachea, which, by its valve-like action, had been the cause of the blocked expiration with the intubation tube in place. This membrane, which was a parietal cast, was easily removed by suction in a few minutes. The area was swabbed by antitoxin locally and a long tracheal intubation tube introduced. The membrane was confined to the trachea. There was no evidence of membrane in either bronchus. The temperature, pulse and respiration gradually reached normal on March 17, the third day after admission. The tube was removed on this day through the intubation speculum and the child remained without the tube. The general condition of the patient continued to improve and she was discharged from the hospital March 31. There were no complications. The primary cul-

ture taken from the throat by the usual swab method was positive for diphtheria bacilli. The direct tracheal cultures also proved positive.

Case 19. John C., age 3 years, ill one day, was admitted to the Kingston Avenue Hospital, March 20, 1914, suffering with tracheal diphtheria. There was no clinical evidence of any membrane on the tonsils, pharynx or nares. The voice was perfectly normal, showing that the larynx was not involved. There was moderate degree of retraction and the pulse was aspirate at times. A fair amount of air entered both lungs with no area of definitely diminished respiratory murmur. The heart action was rapid. The larynx was examined by direct inspection and was seen to be quite normal; the vocal cords were not congested. Some subglottic infiltration was present. The cough was constricted, but the attacks of dyspnea would improve at intervals and were not increased by the direct laryngeal examination. There was very slight cyanosis of the finger tips. The color of the face was good. The patient was not intubated. The larynx was poulticed and a dose of 15,000 units of antitoxin was administered. The temperature was 101.4° F.; pulse, 130; respirations, 30. The primary culture taken from the pharynx by the swab method was negative, while the culture taken by means of a Coolidge applicator from the larynx was positive. The following day the general condition of the child had improved. The dyspnea was less marked and the cough was not so constricted. A second culture taken from the pharynx by the usual swab method on this date was positive, and the later cultures were alternately positive and negative until April 9, when, after two consecutive negative cultures, the patient was discharged. There were no complications. This case illustrates the gratifying results which can be obtained without instrumentation when the disease is recognized early.

Case 20. Sadie A., age 4 years, ill three days, was admitted to the Kingston Avenue Hospital, March 27, 1914. Intubated with a 4-5 O'Dwyer tube. The tube gave no relief and, in fact, almost completely obstructed respiration so that it was immediately removed by Dr. Dickson and a longer tube introduced. This tube also gave no relief and it was removed. There was no visible exudate on the tonsils nor was there any nasal discharge. The temperature was 101°; pulse, 146, weak and rapid; respirations, 44, and labored. There was inspiratory-expiratory dysphea, decidedly asthmatic in character, accompanied by marked cyanosis and retraction. Little air entered either lung and no difference in the physical signs was noted with or without the long laryngo-tracheal intubation tube in place. The tube was removed and replaced a number of times without relief and finally Dr. Cannon decided to perform tracheotomy. On opening the trachea he removed a cylindrical cast. The tracheal canula became plugged on introduction and was immediately removed. When I arrived at the hospital, about two hours later, I found the child *in extremis*, active stimulation having kept the child alive until my arrival. A 7 mm. tracheoscope was passed through the tracheotomy wound. The trachea was partly free from membrane, a portion having been removed by Dr. Cannon after performing tracheotomy. The lower trachea and both bronchi were found to be completely obstructed with cylindrical casts which were rapidly removed by suction, a ten-inch vacuum being used. On further inspection the superior lobe bronchus on

the right side was obstructed and the remaining membrane had torn off the right bronchial cast. The middle and lower lobe bronchi were also occluded. The same obstruction was present in the left bronchus and this membrane was also removed. All of the membrane was removed as far as possible from the main bronchi and their branches, and only the parietal plaques of ulceration remained to be seen. The condition of the child apparently improved after the removal of the membrane and certainly more air was entering the lungs. The surfaces of the trachea and bronchi were swabbed with antitoxin and a long tracheal canula of Dr. Jackson introduced. Suction was kept up from time to time through the tracheal canula. The temperature rose to 102.4° after the manipulation, and the respirations to 60. The pulse was weak and almost imperceptible, even though the heart had been supported by camphor, morphia, and adrenal. A dose of 20,000 units of antitoxin, which had been given by intramuscular injection, had not had time to have any effect, and the unfortunate little girl died the following day, just ten hours after admission. The larynx, which was examined post-mortem, showed no involvement above the cricoid cartilage. All of the cultures were positive.

Case 21. Domonic T., age 5 years, ill (?) days, was admitted to the Kingston Avenue Hospital, March 28, 1914. Intubated for laryngeal diphtheria with a 4-5 O'Dwyer tube. On admission there was no clinical evidence of membrane in the nares, on the tonsils or pharynx. The temperature was 103.4°; pulse, 136; respirations, 44, and labored. There was marked dyspnea and retraction of the epigastrium and cyanosis of the extremities. The heart action was rapid and irregular, and the pulse was of the aspirated type, that is, a pulse which disappeared with each inspiration. Coarse, moist, transmitted rales were present over the upper lobe areas. It was impossible to examine the lower limit of the chest owing to the marked retraction. There was, however, little air entering either lung. A dose of 20,000 units of antitoxin was given intramuscularly in the gluteal region. As the 4-5 tube had given no relief, the tube was removed and a longer tube introduced by Dr. Rosseter. The longer tube improved the condition temporarily but within one hour extubation was necessary because the lumen had become obstructed and expiration as well as inspiration was completely blocked. A small ribbon cast followed the removal of the tube. By direct laryngeal examination, preliminary to passing the bronchoscope, no membrane was visible. The vocal cords and ventricular bands were congested from the repeated intubations. On passing the 5 mm. bronchoscope, a flapping piece of membrane was seen in the trachea extending into the right bronchus, at which point it was attached; this was removed by suction. There was some edema about the mouth of the superior lobe bronchus but no further exudate was visible. The left bronchus was also involved just below the carina. The trachea and bronchi were sprayed with antitoxin and a long tracheal intubation tube introduced. The following day, March 29, there was a diminished area of respiratory murmur over the right upper lobe anteriorly, with increased percussion resonance over this portion of the lung. This was thought to be a small area of diphtheritic pneumonia and no further attempt was made to relieve this patch of plugging by bronchoscopy. On March 31, the temperature, pulse and respiration were gradually falling to normal, but the patch in the upper lobe remained.

The tube was coughed out on this day and further intubation was not necessary. The cough was troublesome after auto-extubation and some curdy digested pieces of membrane were expectorated. The temperature did not fall to normal after the tube was dispensed with but gradually fell to normal on April 7. There was no doubt that the area noted over the superior lobe was a diphtheritic broncho-pneumonia. The boy made a perfect recovery and was discharged April 23, 1914. Cultures from the pharynx by the swab method were negative, but were positive from the trachea and bronchi.

Case 22. Louis B., age 5 years, ill two days, was admitted to the Kingston Avenue Hospital, April 1, 1914, suffering with tracheal diphtheria and was intubated after admission with a 4-5 O'Dwyer tube. On admission the child was in poor condition. Temperature, 103.2°; pulse, 142; respirations, 36. There was marked retraction of the supraclavicular and sternal notches and dipping of the epigastrium. The dyspnea was inspiratory-expiratory and decidedly asthmatic. The voice was not lost and the child was able to cry. On physical examination, before intubation, little air was entering either lung. On intubation the condition was relieved temporarily, but within one hour the tube became blocked and was immediately removed and a longer tube introduced, which went below the site of the membrane. This gave prompt relief. With the removal of the first tube a cast of the trachea followed and as the long tube had apparently relieved the stenosis, no attempt was made further to remove the membrane by bronchoscopy. With the direct introduction of the long tracheal tube the larynx and vocal cords were seen to be normal. The tube remained in the larynx and trachea for five days, after which date it was removed and the child made a perfect recovery. Reintubation was no longer necessary. The patient remained in the hospital for the customary three weeks after extubation and was discharged cured April 26, 1914. All of the cultures were negative. There were no complications.

Case 23. Helen B., age 4 years and 11 months, ill five days, was intubated by Dr. Laub, one of the ambulance surgeons, at the home and rushed to the hospital. The child was *in extremis* at the time of the intubation and the short tube did not relieve the stenosis. In fact, no tube could have relieved such complete obstruction of the tracheo-bronchial tree. The child died while on the way to the hospital and was bronchoscoped post-mortem. There was diphtheritic exudate and ulceration on the tonsils and pharynx. The larynx was covered with small areas of membrane, the vocal cords were not visible. The trachea and both bronchi were filled with cylinder and ribbon casts. No autopsy was permitted. This case illustrates one of many which are not recognized until the obstruction of the respiratory tract is complete, and the probable reason why the stenosis was overlooked in this case was that the membrane starting from below upward gave little symptomatology other than that of a catarrhal bronchitis until the larynx became obstructed.

Case 24. Alesio L., age 5 years, ill three days, was admitted to the Kingston Avenue Hospital, April 14, 1914. The child was intubated with a 4-5 O'Dwyer tube prior to admission by one of the ambulance surgeons. The tube became blocked shortly after introduction and was

removed but no cast of membrane followed. Immediate reintubation was performed with the same size tube, and for the second time expiration became blocked and the tube was removed. Respiration was much easier without the tube. With the tube out of the larynx the voice was fairly good. On admission to the hospital the patient was in fair condition, with moderate degree of retraction and cyanosis. The temperature was 100°; pulse, 136; respirations, 32. A dose of 30,000 units of antitoxin was administered intramuscularly. The physical signs in the chest were those of bronchial obstruction. There was little air entering the left lung in comparison to the intake of air in the right lung. The percussion note was high-pitched over the left upper lobe. The boy did fairly well without the tube during the night but became markedly dyspneic and cyanotic the following morning and reintubation was necessary, a longer tube being introduced by Dr. Cannon. This gave some relief but did not entirely relieve the expiratory dsypnea. On arrival at the hospital I found the condition as already described, but the dyspnea and cyanosis had become worse during the past hour. The tube was removed through the writer's intubation speculum and the larynx was noted to be free from membrane. The vocal cords were congested and the arytenoid cartilages slightly infiltrated. On passing the 5 mm. bronchoscope of Dr. Jackson there was a long ribbon cast on the left lateral wall of the trachea extending down into the left bronchus, the tracheal end of the cast being detached and acting like a valve. The right bronchus was not involved. A suction tube was introduced through the bronchoscope and the membrane removed. The left and right bronchi were sprayed with antitoxin and a long intubation tube inserted into the left bronchus, the head being rotated with the laryngeal speculum in place so that the tube would pass into the left bronchus easily. The temperature, which was only 100° on admission, was taken shortly after the manipulation and recorded as 104.6° F.; pulse, 136; respirations, 38. The day following, Dr. Joyce thought, from the scattered transmitted rales over the right lung, that broncho-pneumonia was developing, but the temperature gradually fell to normal on April 19. The tube was removed in fifty-six hours and reintubation was not necessary. The pulse was irregular after the removal of the tube, and there were frequent spells of coughing and attacks of "croup" and dyspnea which gradually disappeared within the next twenty-four hours. The only complication was tachycardia, which persisted for eighteen days. The child was discharged cured and with a good voice on May 10, 1914. All of the cultures taken by the swab method from the pharynx as well as the direct laryngeal and tracheal cultures were negative.

Case 25. P. W., age 9 years, ill two days, was admitted to the Willard Parker Hospital, April 15, 1914, suffering with tracheal diphtheria. The voice was not lost but there was marked inspiratory-expiratory dyspnea. There was no clinical evidence of exudate on the tonsils, pharynx, or nares. The temperature was 100°; pulse, 138; respirations, 32. There were numerous scattered rales and harsh respiration over the sternal notch and bronchial areas. The respiratory murmur was markedly diminished over both lungs owing to the tracheal stenosis. The patient was intubated with an 8-9 O'Dwyer tube, which relieved the stenosis

temporarily but later became blocked and respiration was again difficult. The tube was removed but no membrane was coughed out. Reintubation was performed with a 10-12 O'Dwyer tube, which also gave temporary relief but became blocked, making expiration difficult. This case presented a splendid example of blocked expiration in comparison to the rather free inspiration. This tube was again removed but reintubation was necessary within thirty minutes. A dose of 20,000 units of antitoxin intramuscularly had been administered. When I arrived at the hospital, the tube had been removed for the third time and the patient was breathing fairly comfortably, but by the time the instruments were ready the dyspnea was again troublesome. No clinical evidence of membrane on the tonsils or in the laryngo-pharynx was present on direct inspection. The larynx was free from exudate but the arytenoid cartilages were much swollen. There was some subglottic infiltration. The cords and ventricular bands were very red, probably due to the many intubations. The 5 mm. bronchoscope of Dr. Jackson was passed and a parietal cast of membrane was seen about the level and below the sternal notch. This cast was easily removed and the area swabbed with antitoxin. The dyspnea was relieved by the removal of the membrane but to be on the safe side, a long 8.5 cm. intubation tube was introduced which passed below the site of the remaining tracheal edema. There was no involvement of either bronchus. The temperature rose to 102.4° after the manipulation and dose of antitoxin, but was normal on April 18, the third day after admission. The tube was removed on the fourth day. There were slight, "croupy spells" during the first five days after the removal of the tube, but these gradually subsided and the boy made a perfect recovery. All of the cultures taken from the pharynx were negative. Cultures taken from the cast removed were positive. There were no complications. The patient was discharged on May 6, 1914.

Case 26. L. L., age 5 years, ill three days, was admitted to the Kingston Avenue Hospital, April 14, 1914. The child was in poor condition and was intubated shortly after admission with a 4-5 tube which apparently relieved the stenosis. About one hour later the child became very restless and dyspneic, for the tube had become obstructed with membrane. The tube was removed, followed by a ribbon strip of membrane which was still in the lower end of the tube. The 4-5 intubation tube was replaced and the stenosis relieved. Six hours later even after a dose of 20,000 units of antitoxin the tube again became obstructed and extubation was necessary. A direct laryngeal and prochoscopic examination was made the same day with the following findings: There was no visible membrane on the tonsils or pharynx and no nasal discharge. The larynx showed marked congestion. There was a small amount of exudate on both arytenoid cartilages. The ventricular bands were swollen but free from membrane. The vocal cords were beefy red and from the right cord a small piece of membrane was hanging into the subglottic space, which was blown out and sucked back by expiration and inspiration. The 5 mm. bronchoscope was introduced after the loose piece of membrane had been removed from the vocal cord. The subglottic area at the cricoid level was covered with membrane which was continuous down to within two centimeters from the carina. There was an absence of membrane on the

left lateral wall. There was no apparent involvement of the bronchi. All of the membrane, with the exception of a few very small parietal plaques was firmly attached. A small suction tube with a six-inch vacuum removed the membrane from the trachea, while the membrane from the cord was removed by forceps. The duration of the operation was fifteen minutes. After the removal of the diphtheritic exudate the whole larynx and trachea was swabbed with antitoxin and a long laryngo-tracheal intubation tube introduced. The temperature on admission was 100°, but gradually rose to 103°. Pulse, 128; respiration, 38. No definite sign of pneumonia could be elicited, nor was there any diminished respiration over either lung. The tube was removed on April 16, forty-eight hours after introduction. There were a few attacks of slight dyspnea after the removal of the tube but reintubation was not necessary. The temperature, which had reached 104.6°, gradually fell to normal on April 19. With the fall in temperature the pulse became very weak and irregular. The voice remained very hoarse for ten days and gradually returned to normal. The patient was discharged May 10, 1914. All cultures taken from the pharynx were negative. Bronchoscopic cultures were all positive.

Case 27. Lauren C., age 3 years, ill (?) days. The child was *in extremis* and wheezing like an asthmatic on admission to the hospital. She was intubated immediately with a three-year O'Dwyer tube, which gave no relief, and the tube was removed and a longer tube introduced. The child was intubated by the family physician, but on the way to the hospital the tube was coughed up, and as the ambulance surgeon thought the child was breathing better without the tube, it was not replaced until the hospital was reached, when Dr. Dickson, of the house staff, recognized the case as one of low membranous diphtheria. The reintroduction of the tube by Dr. Dickson gave no relief and it became so obstructed that a rapid tracheotomy was performed with the intubation tube as a guide. As soon as the trachea was opened, Dr. Dickson rapidly removed the intubation tube by means of the attached string, and introducing a short bronchoscope he removed a mass of membrane from the trachea and both bronchi. The lumen of the bronchoscopic tube became obstructed on introduction but the child did not have sufficient expiratory cough to dislodge the membrane from the lumen of the tube. After the removal of the membrane a long tracheal canula was introduced and suction by means of a catheter applied at frequent intervals whenever there was any sign of obstruction. I saw the child shortly after the removal of the membrane by Dr. Dickson, and as she was apparently improved, I made no further examination. The temperature, which was 102°, rapidly rose to 104.6° a few hours after the removal of the membrane. The pulse was counted at 158, and the respirations at 68. The general condition of the patient gradually became worse. The lungs were filling with moist rales, which were not present at the time of admission, and the physical signs were those of pulmonary edema. The respirations were labored. The use of continuous suction through the tracheal canula gave no relief and the child died eight hours after admission to the hospital. The temperature rose to 107° just before the end. All of the cultures taken from the membrane were positive. The lungs at necropsy showed areas of consolidation and on section dropped

blood. The visceral pleurae were covered with air blebs, some of them 2 cm. in diameter. The volume of the lungs was apparently increased from these emphysematous areas. There were small areas of exudate and ulceration in the larynx, trachea and bronchi. An exudate covered the lower trachea which was probably not removed. There was a thin exudate on both tonsils. The fine bronchioles were completely occluded. There was marked infiltration of the larynx and trachea. The areas of pneumonia were purely diphtheritic and cultures from these areas showed Klebs-Loeffler bacilli in abundance. Histologically the lung showed marked necrosis of the alveoli as well as the lumen of the bronchus. There was marked proliferation of new small round cells, plasma cells and numerous fibroblasts. The alveoli were filled with leucocytes, fibrin and red blood cells. The alveolar septa as well as the surrounding lung tissue were necrotic. The heart was dilated. There were a few air blebs on the outer surface of the pericardium. There were also numerous blebs at the root of the lung. There was no apparent rupture of these blebs, and no subcutaneous emphysema.

Case 28. Tony L., age 4 years, ill two days, admitted to the Kingston Avenue Hospital, May 26, 1914, suffering with laryngeal diphtheria. There was no clinical evidence of exudate on the tonsils; there was a slight nasal discharge. The temperature was 102.6° on admission, the respirations 32, and the pulse 140. A dose of 20,000 units of antitoxin was administered, none having been given prior to admission. The child was intubated before admission by one of the ambulance surgeons, with a three-year O'Dwyer tube. The tube relieved the condition temporarily, but one hour later it became obstructed and was promptly removed and a 4-5 tube introduced. This tube, like the former, temporarily relieved the dyspnea, but owing to a loose piece of membrane at the lower end of the tube, which was obstructing expiration, the tube was removed and a direct laryngeal and bronchoscopic examination made. With the intubation tube in the larynx there was a sufficient amount of air entering the lungs but there was difficulty with expiration. Without the tube there was marked dyspnea, both inspiratory and expiratory, and little air entered the lungs. The physical signs in this case demonstrated beautifully the valve-like action of the membrane in obstructing expiration. On removing the tube by the direct method the larynx was seen to be covered with thin, patchy areas of diphtheritic exudate. The vocal cords and ventricular bands were covered with thin patches of membrane and the arytenoid cartilages enormously swollen. There was rather severe dyspnea during the direct examination, which had only taken a few moments, but as soon as the 5 mm. bronchoscope was passed the dyspnea was immediately relieved. A loose piece of membrane was visible in the trachea at the level of the sternal notch. This loose piece was part of an imperfect cylindrical cast which was readily removed by suction. There was no visible membrane in either bronchus or their branches. There was no bleeding following the removal of the membrane for these casts attached to ciliated epithelium are rather easily removed. There was, however, some bleeding when an attempt was made to remove the thin, patchy areas of membrane from the larynx, for the membrane is firmly adherent to mucous membrane covered by squamous epithelium. The

larynx and trachea were swabbed with antitoxin after the removal of the membrane by means of a Jackson sponge-holder, and a long 7 cm. intubation tube introduced. The temperature did not rise following the manipulation and gradually fell to normal on May 30, four days after admission. The tube remained in place for seventy-two hours, after which it was removed. But as the arytenoid cartilages were still infiltrated, the tube had to be replaced within fifteen minutes, a 4-5 O'Dwyer tube being used. There was a slight rise in temperature, after the removal of the tracheal tube, but the temperature fell to normal the following day. On June 6, with the child in good condition and the swollen arytenoids having returned to normal, the tube was finally dispensed with and the child remained without the tube and had no further difficulty with respiration. There was slight tachycardia at times and the child was kept in bed for one week. On June 20, 1914, the patient was discharged cured. All of the cultures taken by pharyngeal and bronchoscopic swab method were negative. Cultures from the membrane were positive for Klebs-Loeffler bacilli.

Case 29. Mary C., age 4 years, ill four days, was *in extremis* on admission to the hospital, June 24, 1914. The child was seen by Drs. Dickson and Eberle who performed tracheotomy in an endeavor to remove the membrane from the trachea and bronchi. The intubation tube had given no relief. The child had been treated for broncho-pneumonia at her home and it was not until the stenotic symptoms became alarming that diphtheria was suspected as the cause of the trouble and the parents were advised to send the child to the hospital. No antitoxin had been given prior to admission, but a dose of 20,000 units was administered on admission. Tracheotomy and lower bronchoscopy were of no avail and the child died three hours after admission. There was a follicular exudate on the right tonsil. There was no nasal discharge. The larynx was markedly congested and there was a loose piece of membrane hanging from the right vocal cord. The ventricular bands were also involved, and the arytenoid cartilages markedly infiltrated. There was a long ribbon cast in the trachea on the antero-lateral walls. Part of this cast had been removed and the cast was probably a complete cylinder cast similar to the casts seen at the carina and in both bronchi. Had I been able to obtain an autopsy the specimen would have been a complete cylinder cast of the entire laryngo-trachea and bronchial tree. This case demonstrates rather forcibly why I believe that the membrane may start primarily in the bronchi and travel upward and not until stenosis becomes extreme is the true nature of the condition recognized when it is unfortunately too late to save life.

Case 30. W. W., age 5 years, ill five days, was admitted to the Kingston Avenue Hospital, July 11, 1914. Intubated for laryngeal diphtheria. This case, like the former, had been diagnosed broncho-pneumonia until the tonsillar exudate revealed the true nature of the disease. No antitoxin was given prior to admission. Intubation was performed by Dr. Adam Eberle with a 4-5 O'Dwyer tube, which gave no relief, for as soon as the tube was introduced the child became black and ceased to breathe. The tube was at once removed and a cast of membrane 4 cm. long followed. A longer tube was introduced by Dr. Eberle, but this tube had no effect.

Dr. Eberle attempted to remove all of the membrane possible but the child died eleven hours after admission. The temperature remained at 104.4°; pulse, ?; respiration, 44. The necropsy showed a complete cast of the tracheo-bronchial tree. All of the cultures were positive.

Case 31. B. P., age 3 years, ill two days, was admitted to the Kingston Avenue Hospital, August 28, 1914. There was no visible exudate on the tonsils nor was there any nasal discharge. No antitoxin was given prior to admission, but a dose of 20,000 units was administered intramuscularly on admission. The temperature was 103.4°; pulse, 136; respirations, 40. Retraction was moderate and the pulse aspirate. By the aspirate pulse is meant a pulse which disappears with each inspiration and is usually one of the chief indications for intubation. The larynx was poulticed and a dose of Dover's powder given. The stenosis continued to grow worse and in spite of the poultice to the larynx and Dover's powder, the child was intubated six hours later with a three-year rubber O'Dwyer tube. The physical signs of the chest were unsatisfactory before intubation, for little air was entering either lung. After intubation, more air entered the lungs but expiration was interfered with owing to membrane below the tube. There was, however, slightly diminished respiration over the right upper lobe with many scattered subcrepitant and transmitted rales over the entire chest. At the sternal notch there was a flapping sound with the tube in place. The intubation relieved the dyspnea temporarily but as the tube became obstructed shortly afterwards, extubation was performed and with the removal of the tube a cast of membrane followed. The tube was promptly reintroduced but instead of relieving the stenosis this time it made the trouble worse and it was again removed and the child breathed fairly comfortable. At times, when the intubation tube does not give the desired relief owing to some obstruction below, if the tube is removed promptly the patient will invariably breathe better without the tube. Later, when the stenotic symptoms become troublesome, the tube may be re-inserted. The child remained without the tube for thirty minutes when the stenosis again became extreme and intubation was necessary, a long tracheal tube being used. This tube, which was 7 cm. in length, gave the desired relief. No attempt was made to bronchoscope the child after I saw him for the manipulation of frequent intubation and extubation had almost exhausted the patient. On August 30, the temperature had fallen to normal and the pulse was 134, respirations 34. Sufficient air was entering both lungs; the heart action was regular. The tube remained in place until September 2, when it was removed at eleven-thirty a. m. The child did fairly well without the tube until five p. m., when, owing to progressive stenosis, intubation was necessary, a three-year O'Dwyer tube being used. The condition of the child continued to improve and again the tube was removed under direct inspection on September 7, five days later, and as there was no arytenoid infiltration, the child remained without the tube. There was a loose cough following the removal of the tube and the voice was husky for ten days but gradually returned to normal. The child was discharged September 19, 1914. All of the cultures taken by the swab method were negative.

Case 32. Harriet G., age 2 years and 7 months, ill three days, was admitted to the hospital, September 16, 1914. The child was intubated on

admission with a one-year O'Dwyer tube but it gave no relief. The tube was removed by Dr. Raymond Laub and a longer tube introduced, which temporarily relieved the stenosis, though expiration was at times difficult. A thin exudate was present on the tonsils; there was no nasal discharge. A dose of 20,000 units of antitoxin was administered intra-muscularly. The temperature was 101°; pulse, 136; respirations, 30. An area of diminished respiratory murmur could be elicited over the right upper lobe anteriorly with many rhonchi scattered over this area. Expiration was shortened. A second physical examination was made the same afternoon, for the tube had not relieved the dyspnea, and bronchoscopy was indicated. With the tube out of the larynx the child breathed fairly well for twenty minutes. The physical signs with the tube removed elicited an area of diminished breathing over the right upper lobe anteriorly with increased percussion resonance, the signs over this area being similar to the findings with the tube in place but the many transmitted rales were removed. There was exaggerated respiration over the left lung with normal percussion resonance. A good volume of air was entering this lung. Dr. Laub and other members of the staff thought the diminished respiratory area over the right lung was due to a broncho-pneumonia, which was probably correct, but of dipththeritic origin. The following day the temperature had risen to 104.2° pulse, 164; respirations, 40. The area of so-called pneumonia was still present in spite of the removal of membrane from the right bronchus and superior lobe. On direct inspection the larynx showed a slight amount of membrane on the left cord and ventricular bands. There was no exudate on the epiglottis. The arytenoid cartilages were slightly swollen but free from membrane. There was apparently some subglottic stenosis. On passing the 5 mm. bronchoscope of Dr. Jackson, membrane which was a long ribbon cast attached to the right lateral wall for about three centimeters, was plainly visible as soon as the tube entered the trachea. There were patchy areas below this cast which involved the right bronchus. With the small aspirating tube this cast was easily removed. On reaching the bifurcation and entering the right bronchus, two loose pieces of membrane were coughed into the lumen of the tube which promptly obstructed vision, and while the tube was being removed the membrane was coughed through the lumen of the bronchoscope and lodged on the glasses of the operator. The lenses were removed by a nurse and a clean pair of warmed glasses adjusted. The membrane which was coughed out was the piece which involved the right bronchus for after the exit there was no further membrane present though the lumen of the bronchus was covered with small ulcerations. The superior lobe bronchus was also partially occluded, but with the curved suction tube the orifice was entered and some small strips of membrane removed. There was no involvement of the stem bronchus, or of the middle or inferior lobes. The left bronchus was free from involvement. After the removal of the membrane the parts were swabbed as usual with antitoxin and the long 7 cm. intubation tube introduced. The intubation tube was removed forty-eight hours later and with the violent cough which followed its removal, considerable digested membrane was expelled. While reintubation was not necessary, the child was far from being in the best of condition. The temperature continued to remain between 102° to 104°, with re-

missions after alcohol sponges. The pulse and respirations corresponded proportionately to the temperature, 160 and 60 respectively. The cough was troublesome and the child very restless. On September 22, six days after admission, the temperature was 105°; pulse, 166; respirations, 64. There was an area of bronchial breathing over the right upper lobe antero-laterally; this was the area of consolidation elicited by Dr. Laub on admission of the child to the hospital, and was in all probability, as already stated, of diphtheritic origin. This area of consolidation gradually disappeared and three days later, by September 26, the temperature had reached normal and the pulse and respirations had reached 100 and 24 respectively. From this date the general condition of the child gradually improved and she was discharged from the hospital October 13, 1914. All of the cultures were negative by the usual swab method but were positive when grown from the secretions aspirated from the lung.

Case 33. Grace T., age 19 months, ill three days, was admitted to the Kingston Avenue Hospital, September 19, 1914. There was marked retraction on admission but the voice was not lost and the child was able to cry. The child was intubated shortly after admission with a one-year O'Dwyer tube. The tube gave relief for the interval while 20,000 units of antitoxin was being administered, but shortly afterwards the tube was removed on account of expiratory difficulty and a two-year tube was substituted. This tube, like the one-year tube, did not give sufficient relief and it was necessary to remove the tube in one hour. During the time a thorough physical examination was made by Dr. Joyce, who noted, by inspection, that there was marked bulging of the left chest wall, which was much larger than the right. On auscultation little air was found to enter the left lung on inspiration in comparison to the volume of air that entered the right lung. Difficulty and short expiration was noted over both lungs. On percussion, the note was high-pitched and almost tympanitic over the left lung, with no apparent increase over the right lung. The contrast of the two notes over the left and right lungs was marked. The temperature was, on admission, 100°; pulse, 150; respirations, 40, and labored. As retraction, dyspnea and cyanosis persisted even after the removal of the two-year tube and the introduction of a longer tube was necessary, Dr. Joyce notified me of this case, and on my arrival at the hospital the child was bronchoscoped after I had confirmed the findings of the physical examination. The tonsils were free from visible exudate; there was no nasal discharge. The intubation tube was removed under the direct guidance of the eye. The larynx was free from membrane. The vocal cords and ventricular bands were congested. On removing the tube the child was able to cry. There was no apparent subglottic swelling. The 5 mm. bronchoscope was introduced, and no membrane was visible until the lower left lateral tracheal wall was reached, when a snow-white flapping membrane was plainly visible. This piece of membrane was rapidly removed by suction, and after the removal the carina was located and the right bronchus inspected. There was no trace of any membrane in the right bronchus or any of its branches. The tracheal piece of membrane removed was continuous with a ribbon cast involving the left bronchus only. The whole of the bronchial wall was apparently edematous. This strip of membrane extended beyond the superior

lobe bronchus. The membrane was removed by the small suction tube and the lower lobe bronchus examined. Some secretion and a few shreds of membrane were removed from this bronchus. Antitoxin was injected, 1 cc., by a long syringe into the left bronchus and the excess removed by aspiration. An intubation tube 7 cm. in length was introduced. The following day the temperature was 102.4°; pulse, 56; respiration, 40. The physical signs in the lung had not materially changed and there were many scattered rales and high-pitched percussion resonance over the left lung. The temperature gradually reached normal forty-eight hours later and the intubation tube was removed. The child did well without the tube until September 25, when the temperature began to rise and the child was dyspneic and restless. The larynx was poulticed and this seemed to relieve the dyspnea but breathing was not natural. On September 27, the dyspnea became so marked that reintubation was necessary, a two-year O'Dwyer tube being used. After intubation, the gradual exhaustion was relieved and the temperature fell to normal. On October 5, the tube was auto-extubated and there was no further difficulty with respiration. The child was detained in the hospital for a prolonged period after the tube was coughed up to make sure that there would be no further laryngeal stenosis. This case illustrates the post-tubal stenosis which may occur from one week to ten days or even longer after primary intubation. There were no complications. All of the throat swab cultures were negative. The secretion and membrane showed diphtheria bacilli.

Case 34. S. A., age 2½ years, ill six days, was admitted with post-nasal, glandular and laryngo-tracheal diphtheria, September 21, 1914. The child was *in extremis* and very toxic. A dose of 25,000 units of antitoxin was given, none having been administered prior to admission. There was extreme cyanosis. The anterior nares were completely obstructed with membrane and there was a sero-sanguineous discharge from the nose. Little air entered either lung even with the tube in the larynx. The percussion note was high-pitched over both lungs. Camphor in oil, three grains, was given by hypodermic injection every hour. Three hours after admission the dyspnea became marked. A series of intubations and extubations with long tubes gave no relief and Dr. Laub performed tracheotomy and removed a cast of membrane from the trachea and bronchi. No attempt was made to examine the larynx on account of the enormous amount of pharyngeal edema. A long tracheal canula was introduced after the removal of part of the membrane but the canula soon became obstructed and had to be removed. A cast of membrane was removed from the lumen and the tube was reintroduced. After the operation, the condition of the child, which had been very poor on admission, gradually became worse. The temperature, 102° on admission, was now 106°; pulse, 170; respirations, 68. The child, however, lived in this condition during the night and died the following morning, thirteen hours after admission to the hospital. At autopsy the lungs were filled with membrane and demonstrated the complete obstruction in a case of six days' duration without antitoxin. There were patchy areas of consolidation and emphysema and the volume of the lungs was apparently increased. All of the cultures were positive.

Case 35. F. M., 4½ years, ill (?) days, was admitted to the Willard Parker Hospital, October 23, 1914. No exudate was present on the tonsils and there was no nasal discharge. There was marked retraction and a peculiar "croupy cough," not laryngeal. The voice was not lost. A dose of 5,000 units of antitoxin was given, 15,000 units having been given three hours before admission to the hospital. On physical examination, scattered rales were heard throughout both lungs. There was little air entering the left lung and the percussion note over the lung anteriorly and posteriorly was high-pitched. No apparent involvement of the right lung was found, although the respiration was very harsh and almost like bronchial breathing. Over the sternal notch there was a rattling sound, most marked on expiration. The child was taking very short breaths and evidently trying to breathe as easily as possible to avoid coughing. The boy had been intubated by the ambulance surgeon with a 4-5 tube before admission to the hospital, but as the tube became blocked, it was removed, and even though no membrane was coughed up, the child breathed much better without the tube. Owing to slowly progressive dyspnea and increasing cyanosis, reintubation was neecssary three hours after admission, the 4-5 tube being replaced. As this tube, like the former, made the stenosis much worse, it was removed and a longer tube introduced. The long tube seemed to improve the breathing temporarily but later it became constantly obstructed on expiration and had to be removed. Direct laryngoscopy and bronchoscopy were resorted to in order to relieve the condition. The larynx was free from diphtheritic membrane, and the cords and ventricular bands were congested from the intubation tubes, but free from membrane or ulceration. The trachea was apparently normal when viewed through the 5 mm. bronchoscope and no membrane was seen until the sternal notch was reached. The membrane was loose at the upper end and was a torn cast. This ribbon-like cast extended downward on the left lateral tracheal wall and was a distinct cylinder cast at the bifurcation, completely closing the left bronchus. The case was removed by aspiration but there were several torn pieces left. Both superior and inferior lobe bronchi were seen to be completely occluded. This membrane was removed as well as possible but some of it was left behind. As the child was not doing well and I had been working for fifteen minutes, I decided to swab the bronchus with antitoxin and rapidly intubate with a long tube. The general condition of the child was decidedly improved after the removal of the membrane, and the cyanosis almost entirely disappeared. The action of the heart was good, for it had been supported by a dose of morphia, gr. 1/32 and 1/300 of atropia. The boy had a fairly comfortable night but the following morning his condition had become much worse and the long intubation tube, having become obstructed, was promptly removed. The membrane had probably reformed after its removal as it was not removed thoroughly owing to the extreme condition of the patient. The boy was markedly cyanotic and sinking rapidly. Large doses of camphor in oil were administered hypodermatically with but little effect. The child's condition grew rapidly worse and he died twelve hours after admission. The temperature did not rise rapidly towards the end as is frequently the case in tracheo-bronchial diphtheria, but had fallen from 102.8° on admission to 101°. The rate of the pulse and respirations were ques-

tionable. No cultures were recorded. The autopsy showed a thick cast of membrane involving the whole of the left bronchus with extension into the superior and inferior lobes. A part of the cast was removed from the lower lobe bronchus during the manipulation of the specimen. The whole lung was involved on the left side and the finer bronchioles were completely filled with thick, tenacious secretion. There were necrotic areas of lung tissue about the fine bronchi. The volume of the left lung was greatly increased over the right lung, which was not involved. The visceral pleura was covered with air blebs. The heart was flabby and dilated. What caused the sudden and fatal termination of the patient after he improved I am unable to state positively. The probability is that the reformation of the membrane with continued mechanical obstruction to respiration and the continued ballooning of the lung causing the extreme cyanosis and pressure on the heart was the primary cause. The diphtheritic toxemia was another cause.

Case 36. Philip F., age 5 and one-half years, ill five days, was admitted to the Kingston Avenue Hospital in moribund condition, December 12, 1914. There was exudate on both tonsils. Repeated attempts with intubation tubes failed to relieve the stenosis and rapid tracheotomy was performed by Dr. Laub, using the intubation tube as a guide. The tube was removed as soon as the trachea was opened. A long cast of membrane was rapidly removed through the tracheal wound by forceps and a long tracheal canula inserted. The child did not rally and died forty minutes after admission. No autopsy was permitted. A direct laryngeal and bronchoscopic examination the same afternoon in the mortuary showed the whole larynx, trachea and bronchial tree to be completely filled with membrane. The piece removed by Dr. Laub was part of the cast which involved the trachea. There was exudate on the tonsils but no involvement of the nares. All of the pharyngeal cultures were positive.

Case 37. E. H., age 4 years, ill eight days, was admitted to the Kingston Avenue Hospital, December 22, 1914. This patient, like the former, was in moribund condition, markedly dsypneic and cyanotic. The child was intubated by Dr. Adam Eberle with a three-year tube, which did not improve the dyspnea. Longer and longer tubes were introduced with the same result. The pulse was very poor and could not be counted. The temperature was 101° and respirations 40. A dose of 20,000 units of antitoxin was administered intravenously. No attempt was made to remove the membrane from the trachea and bronchi. The patient died fifty minutes after admission. No autopsy was permitted. A post-mortem bronchoscopy showed the whole laryngo-tracheo-bronchial tree completely filled with membrane and the lumen of the bronchoscopic tube frequently became obstructed during the examination. The pharynx and tonsils were covered with thick membrane and there was a nasal discharge. The temperature did not rise prior to death but remained at 100°. No culture returns were recorded.

Case 38. John S., age 2 years, ill five days, was admitted to the hospital, December 23, 1914. There was exudate on both tonsils and profuse nasal discharge. The heart-sounds were weak and irregular and the pulse poor. There were scattered rales over both lungs anteriorly and posteriorly. Little air was entering the lungs. The temperature was 101°;

pulse, 144; respirations, 38. The child was very "croupy;" there was marked retraction and cyanosis. A dose of 20,000 units of antitoxin was given and the larynx poulticed. Within half an hour after admission the child became so dyspneic that intubation was necessary, a two-year O'Dwyer tube being used. The short tube gave no relief so it was removed and a longer tube was introduced. The long tube became obstructed shortly after introduction and as it was withdrawn, a short, torn ribbon cast followed. The child remained without the tube for five minutes, the long tube being reintroduced. Three hours after admission the temperature had risen to 103.4°; pulse, 160; respirations, 44. Stimulation with hypodermic injections of camphor, two grains, every two hours, was administered. The same afternoon the child was bronchoscoped. The larynx was covered with an exudate on the ventricular bands and vocal cords; the arytenoid cartilages were much swollen. The five millimeter bronchoscope was passed but it became filled with membrane and had to be removed. A second attempt to remove the membrane by upper bronchoscopy was futile; therefore, the bronchoscope was left in the trachea and a rapid tracheotomy performed, the bronchoscope making a capital guide. As the trachea was opened, a loose piece of membrane was coughed out of the wound. This was the piece which was bothering me by upper bronchoscopy and which I was unable to remove. A 7 mm. short tracheoscope was introduced into the tracheal wound and five pieces of torn membrane were removed from the trachea by suction and forceps. When the carina trachialis was reached both bronchi were seen to be filled with perfect cylinder casts. One could look into the membranous cast covering the bronchial wall but no mucous membrane or bronchial rings were visible. After having worked for twenty minutes and removed the greater portion of the obstructing membrane, a long tracheal canula was introduced. The tracheal wound was not closed and a wet saline dressing applied. Tracheal wounds in these cases should never be closed by sutures, for sutured tracheal wounds rapidly become infected and septic mediastinitis may be the result. While it has been extremely rare for me to have a case of tracheotomy for the relief of tracheo-bronchial diphtheria recover, at the same time, if the wound is closed about the tube, infection invariably follows and the patient, who may have recovered from the diphtheria, succumbs to mediastinitis and pneumonia. On December 25, the temperature had fallen to 102°, though the pulse and respirations remained high. There were many scattered, adventitious sounds throughout the lungs. The percussion note was high-pitched over both upper lobes. Constant suction was applied through the tracheal canula, and much curdled and digested membrane removed. The general condition of the child was gradually improving although the heart action was weak and rapid at times. On December 28, the pulse rate, which had been between 140 and 150, suddenly dropped to 60, followed by a violent gastric pain and vomiting and the unfortunate little patient died a few minutes later. The temperature registered 97° just prior to the end. All of the cultures were positive.

The cases reported are principally from the hospital service where we usually see the severest type of case, although it is not

infrequent in private practice to encounter cases where the diagnosis is incorrectly made until stenotic symptoms become extreme. During the past year very few cases of diphtheria occurred in hospital or private practice; therefore, the mortality was extremely low. Tracheo-bronchial diphtheria occurs in about three per cent of all intubated cases. Before the primary intubation, when laryngeal stenosis is present there is no means of telling whether the case is laryngeal only or whether it is a case with membrane below and involvement of the larynx by extension. Of course, if all cases were bronchoscoped as a routine the diagnosis would be easy; but we never perform a direct and bronchial examination without definite evidence that there is membrane below the intubation tube of Dr. O'Dwyer causing difficulty with respiration. Therefore, I have not classified any case in whom the O'Dwyer tube gave the desired relief as a case of tracheal or bronchial diphtheritic stenosis. The longer tubes which I had made, according to measurements of a series of cadavers of all ages, are from 6 cm. in length for an infant up to eight months to one year of age, gradually increasing from one to two centimeters up to twelve years which measure 12 to 13 cm. in length. These tubes are also used for adults and I have intubated two adult women after having removed the membrane from the trachea and bronchi. The measurement in the adult from the base of the epiglottis to the bifurcation of the trachea is from 14 to 15 cm. in the female and about one centimeter longer in the male. On the other hand, I have measured adult females of eighteen and twenty years respectively and found the laryngo-tracheal measurement to be from 11 to 11.5 cm. Of course, while tracheo-bronchial measurements are of great value, at the same time none of them are absolutely accurate but only approximate. They are, however, of value in selecting the intubation tube for the given case. As I have had little or no success with tracheotomy and the use of the long tracheal canula, I have practically abandoned tracheotomy and resort only to peroral endoscopy because the results are far better. In the hospitals the house staff perform tracheotomy after all measures have failed but the operation has not met with marked success in their hands. Dr. Mosher and others have removed membrane through the tracheal wound and had recoveries. I see no necessity for the operation on the tracheo-bronchial type of diphtheria for the 4 and 5 mm. bronchoscopes of Dr. Jackson give sufficient room for suction tubes and forceps. One is only handicapped by performing tracheotomy and using a larger tube in these young subjects. The shock following peroral endo-

scopy and bronchoscopy in children suffering with tracheal and bronchial diphtheria is nothing in comparison to the shock resulting from tracheotomy. In cases of long standing of five or six days' duration brilliant results are not to be expected for the entire larynx, trachea and lung are filled with a membranous cast. It is, however, rather interesting to note how long these children live with such complete obstruction to respiration. That the membrane may start primarily and travel upward in many of the cases has been fairly definitely proven by direct laryngeal and bronchoscopic examination in the case with slowly progressive dyspnea. At times, the membrane apparently skips one locality in the bronchus and chooses another area. Why this is I am unable to state, although some observers believe that it is due to some anatomical peculiarity. The cases with the early parietal casts are the best for a good prognosis but there are many others with a very unfavorable outlook that make a perfect recovery. Cases with parietal cast will often recover after a large dose of antitoxin and intubation and bronchoscopy are not necessary to remove the obstruction.

The treatment by antitoxin. Antitoxin in large doses is certainly indicated in all of these cases. A dose of 10,000 units is usually sufficient for the cases seen early have a limited amount of involvement, as in the parietal type of membranous obstruction. In severe cases of five or six days' duration with extensive involvement of the tracheo-bronchial tree and necrosis of the lung, I doubt if any amount of antitoxin given has effect. In these cases with weak right heart muscle and poor pulmonary circulation there is some question whether or not the antitoxin ever reaches the site of the local lesion, for the termination of these cases is usually fatal. The writer has seen a number of these cases treated with huge doses of antitoxin, but without result. Subcutaneous injection in many of these cases seems to bring about just as favorable results clinically as antitoxin administration by intra-muscular or intravenous injection. The writer prefers intramuscular injection, and this method is much more frequently used at the hospitals at the present time than formerly. Intravenous injection certainly does the greatest amount of good and is promptly absorbed, but there are some dangers even when given with the small dosage of 10,000 units which Dr. Wm. H. Park recommends at the present time. Personally, I have used intravenous injections in enormous doses, the largest being 110,000 units and the next largest 100,000 units. These were cases of naso-pharyngeal and glandular diph-

theria and had no involvement of the larynx or trachea. In a case of laryngeal diphtheria in a boy seven years of age a dose of 20,000 units of antitoxin was administered by the writer in a case of four days' duration, accompanied by profound prostration. The boy died promptly as soon as the antitoxin was administered. This may be attributed to anaphylactic shock. I cannot say whether it was anaphylactic shock or not, but there was, by the reaction, sufficient shock added to the patient, who was already in a state of shock, and this added element of shock I think was the cause of the sudden death. With every intravenous injection of antitoxin there is a chill, some of the chills being severe and of long duration, a rapid rise in temperature and a rapid and thready pulse. Some cases react much more than others. I have mentioned more than once that intravenous injection of antitoxin, while very beneficial, should be given with extreme caution and if the patient is in a state of shock and profoundly prostrated the dose of antitoxin should be given by intramuscular injection.

The writer's schema of dosage of antitoxin in diphtheria. 1. For all cases with positive cultures showing no clinical evidence, 3,000 units. 2. For cases with exudate limited to the tonsils, 3,000 to 5,000 units. 3. For all cases not limited to the tonsils, but moderate in extent, 5,000 to 10,000 units. 4. For (a) nasal; (b) glandular; (c) laryngeal or tracheo-bronchial types, 10,000 to 20,000 units. 5. For septic or combined cases with (a), (b) or (c), 20,000 to 30,000 units.

Give one initial dose and do not repeat. Smaller doses may be given if the duration of illness is under three days. The general condition of the patient, the amount of local lesion manifest, and the duration of illness should always be taken into consideration and the dose judged accordingly.

Methods of administration. Subcutaneous, intramuscular and intravenous. Intravenous injection is difficult in young children on account of the veins being small and difficult to locate. The amount of prostration present at the time of contemplated intravenous injection should be carefully considered. If the patient is stimulated by the toxemia and not prostrated intravenous injection is comparatively safe. This method has been practiced at the Willard Parker Hospital and Kingston Avenue Hospitals for the past seven years.

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A PLEA FOR THE ELECTRO-CAUTERY IN THE TREATMENT OF LARYNGEAL TUBERCULOSIS.*

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Most laryngologists can readily recall the time when the presentation of a case of healed tuberculosis of the larynx was recognized as an unusual, an unexpected and an important event. Despite our increasing knowledge of tuberculosis in general, we were comparatively helpless when the larynx became involved.

The various methods of treatment employed, including sprays, inhalations, intra-laryngeal injections, the application of lactic acid or of formalin, combined with the open air, the rest and silence cures together yielded but a small and discouraging number of cures.

Neither surgical procedures such as curettage, according to the method of Heryng, nor medical measures such as the employment of tuberculin materially brightened the outlook. As a general rule the prognosis for the victim of laryngeal tuberculosis was very unfavorable, and when progressive ulcerations ensued, about all that could be done, was to attempt to alleviate the suffering of the patient.

The meager results obtained from all the methods of treatment enumerated above gave rise to such a gloomy outlook in both lay and professional minds, that the value and importance of the electro-cautery treatment as announced in the epoch-marking monographs of Mermod,[1] and of Grünwald,[2-3] failed to be generally accepted or appreciated. As I shall endeavor to prove in this paper these original claims for the curative value of the cautery have since been confirmed by many competent observers. Nevertheless, despite these favorable reports even at the present time the importance of the cautery treatment is certainly not recognized by the medical profession in general, and even among laryngologists its use is too frequently neglected.

I cannot but agree with Ruedi[4], when he says, "That many physicians on general principles still neglect the operative treatment of laryngeal tuberculosis can only be due to ignorance of the actual facts. There is no complete parallel between the course of pulmonary tuberculosis and a complicating laryngeal tuberculosis." He adds, "I have seen many cases in which, despite marked improvement in the lungs and despite prolonged conservative treat-

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ment of the larynx, the laryngeal condition stubbornly persisted until operative measures, (usually cautery) were employed a few times, when a prompt and permanent cure resulted."

Clinical Evidence: Let us briefly review the basis for such a positive statement. In a period of six years (1908-1914), Ruedi of Davos treated 575 cases of laryngeal tuberculosis principally with the cautery, sometimes with the curette, or curette and cautery. Of these 575 patients he was able to check up 387 cases; 139 cases, or 35.9 per cent remained healed after a period of from three months up to five years from the time of the last treatment. The operative treatment brought about a cure in more than one-third of the cases. The best results, 52 per cent of cures were obtained in the electro-caustic of vocal cord tuberculosis. The only possible criticism of these figures is that the control period was too short in some cases, but a perusal of Ruedi's article is most convincing.

Ruedi employed the method of Mermod and Siebenmann,[5] which differs from the ignipuncture of Grünwald inasmuch as they endeavor to remove or destroy the greater part of the tubercular lesions at one operation. In his original communication Mermod tabulated the following interesting results concerning some 280 cases treated with curette and cautery. Of these, 60 had remained well for at least one year; 40 cases for two years, and 17 cases over three years, i. e., about 40 per cent of cures with a one year minimum period.

Kreig[6] claims to have cured 60 out of some 200 cases; 29 of which remained well for a period of from one to nine years. Siebenmann's and Benni's[7] statistics are perhaps the most reliable and convincing. Of 65 cases treated with the cautery it was possible to check up 17 cases one year and over, following the last treatment. Eleven of these controlled cases, or 65 per cent had remained well, while 6, or 35 per cent showed recurrences. The number of demonstrable cures (11) out of the entire number treated (controlled and uncontrolled) equals 16.6 per cent. In this country favorable reports are given by Freudenthal[8] and by Pettit[9] of New York.

Levy,[10] of Denver, makes the following statement: "Among the local curative agents as well as palliative measures, none has been so highly praised within the last few years as the galvanocautery and although it is still unrecognized by many it must be accepted at present as one of the most satisfying. . . . If the experiments are accepted, its value will be beyond that of anything else that we have at our command."

Experimental evidence: The question naturally arises as to how the cautery acts, that is, what is its effect on the tuberculous larynx? How is the healing process brought about? In the experiments of Albrecht[11] and those of Wood[12] will be found an answer to these questions. Albrecht inoculated the larynges of rabbits with tubercle bacilli of human origin. The lesions which developed were later treated with the cautery and finally the animals were killed at varying intervals after the cauterization, and the larynges examined histologically.

The illustrations show that apart from the local tissue-death caused by the cautery, an inflammatory reaction takes place in the tissues remote from the actual cauterization. This reaction finally takes on the form of a fibrosis tending to enclose and limit the tuberculous process. In other words, the cautery transforms an indolent, avascular, tuberculous lesion into an active vascular process with a final tendency toward enclosure by hyaline connective tissue, simulating the scar-tissue formation in the spontaneous cure of tuberculosis. The cautery experiments of Wood, performed on the inoculated skins of rabbits yielded strikingly similar results. With your indulgence I should like to throw reproductions of Albrecht's slides upon the screen.

Selection of cases: Cases for cautery treatment should be carefully selected. The general condition as well as the laryngeal lesions should be considered. Patients in the early stages of pulmonary tuberculosis running a slow course with but little fever are the best subjects. Patients showing rapid lung destruction, marked fever and frequent hemorrhages and severe cough should be excluded from the cautery treatment until these symptoms tend to subside. Occasionally, however, cauterization of the larynx will check the cough, or relieve dysphagia and thereby improve the general condition of the patient. As regards the larynx itself, beginning ulcers should certainly be burned away and infiltrates as a rule should be punctured with the cautery, if they are not too extensive. Diffuse and numerous lesions call for judgment on the part of the physician. Vocal cord lesions offer the best prognosis, while interarytenoid tuberculosis is more difficult to eradicate.

The epiglottis, when involved should generally be amputated, as advocated by Lockard[13], and in addition the stump should be cauterized. Occasionally curettage should be combined with cauterization.

Technic: Most writers on this subject have operated by the indirect method, and have found it satisfactory. My own experi-

ence has been almost exclusively with suspension laryngoscopy, which I have carried out under (scopolamin-morphin) cocain anesthesia with very satisfactory results. In my judgment the suspension method, since it enables more accurate work will materially increase the results obtained from the galvano-cautery.

Following the application of the cautery, patients should have hospital care for a few days in order to control any edema which may ensue. Dangerous edema need seldom be feared (about once in 30 cases. Benni—op. cit.), and may usually be avoided by limiting the cauterization to one side of the larynx. An ice bag to the neck and ice pills are indicated to prevent edema and diminish pain after the operation. Orthoform insufflations may also be prescribed.

In my opinion enforced silence on the part of the patient loses much of its importance after the cautery treatment since a local reaction in the larynx constitutes an essential part of this form of therapy.

The physician should no longer sit with folded hands and observe the course of the disease, but in all suitable cases the patients should be given the benefit of electro-cautery treatment. When this is done laryngeal tuberculosis will lose some of its terrors, and a much more favorable prognosis than is usually given will be justified.

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22 West Seventh Street.

REPORT OF A CASE OF SPONTANEOUS HEMORRHAGE FROM THE EAR.*

DR. J. B. SHAPLEIGH, St. Louis.

On November 23, 1915, Mr. W. C. M., 36 years old, consulted me on acount of severe pain in the right ear, of two days' duration, following a severe grippe cold. His general health had always been good, but he was verging on a nervous breakdown from long continued overwork, and for some time before the present trouble began, he had complained of soreness in the neck and pain in the legs which he had considered to be rheumatic. This tenderness in the neck had not entirely disappeared and was found to extend from the occiput and from below the mastoid on the right side to the shoulder but posterior to the sterno-cleido-mastoid muscle. There was no mastoid tenderness.

The right ear showed a typical acute attic suppuration; the mebrana tympani being intensely red and bulging above, with the lower portion practically normal. The usual incision was made through the bulging Shrapnell's membrane and out onto the canal wall. The bleeding was only slight and quickly ceased. The pain in the ear was promptly relieved, but the right side of the head continued to feel full and uncomfortable. There was a free purulent discharge for a few days but this ceased in about a week with no return of pain or fever, and on December 3 the ear was found to be dry, with no perceptible bulging of the membrana tympani, no mastoid tenderness and only slight discomfort in the head.

On December 16, the ear was still dry. The hearing was poor and there was some tinnitus. The membrana tympani now showed some bulging in its upper portion, but very little congestion. There was slight tenderness over the mastoid and back of it. No fever. The possibility of a beginning mastoiditis was considered and another incision of the bulging drum membrane advised. He refused, however, to allow this to be done at this visit. Two days later, on December 18, the mastoid tenderness and the bulging of the membrana tympani still being present.

*Read before the American Otological Society, Washington, D. C., May 9, 1916.

the membrane was again freely incised, and again with only ordinary bleeding.

He was seen again on December 20, when there was found a moderate, purulent discharge from the ear. The mastoid tenderness had entirely disappeared and he complained of nothing except an uncomfortable sense of fullness on the right side of his head.

December 21: This forenoon the patient telephoned that his ear had bled twice that morning; the first time about a tablespoonful, the second about a teaspoonful. Both times the bleeding stopped spontaneously and afterward the ear and head felt better. He also said that there was no pain in the ear and no tenderness behind it and that it was still discharging. The next morning, December 22, I received a telephone message from Dr. Hastings, of Alton, Ill., where the patient lived, saying that he had been called during the night to see Mr. M. on account of severe hemorrhage from the ear. On his arrival he found that the bleeding had stopped, but not before the patient had fainted. There had been considerable purulent discharge from the ear during the previous day but no pain or tenderness. He simply packed the ear with gauze. The doctor could give no exact statement as to the amount of blood lost but thought it must have been very large, since the patient had fainted and he found him very pale and weak, with a scarcely perceptible pulse. He saw in a bowl about a pint of clot. The patient's account of the attack is as follows: "He had gone to bed feeling quite well. During the night he had a coughing spell and at once felt something running from his ear, but had no pain. the subsequent history of the case indicate that what mastoid tenderness then present, was due to pus retention and not to bone involvement. As to the anatomical anomaly of the tissues suggested, I do not know that it has been found. It seems more probable that the blood came from the jugular bulb for we know that dehiscences in the floor of the tympanum sometimes exist whereby the wall of the vein is brought into immediate relation with the lining of the tympanic cavity, and cases have been reported where the bulb was so exposed in the middle ear that By the time a light was obtained his pillow was saturated with blood. Not being able to stop the bleeding, he held a bowl under his ear to catch the blood, and sent for the doctor, but before the doctor came he fainted. The blood did not come in spurts but simply poured out. It was dark in color. He could

not tell how much blood he lost altogether, but there was at least a double handful of clot in the bowl."

December 23: The doctor reports a good night. No recurrence of the bleeding. Pulse better. No fever. No pain about the ear or mastoid. There is some tenderness in the neck, but none in the jugular line, and the patient says this tenderness is the same he had previously had and for which he had consulted an osteopath a few months before. The tampon was removed.

On December 24, I saw the patient. He was still very pale and weak. Pulse fairly good, but soft and compressible. No pain in ear or head. Mastoid not tender but the neck back of the sterno-cleido sensitive and painful. No jugular tenderness. Complains of pain in his legs. Temperature has not been above 99° F. The external canal was negative and contained no clot. Its walls presented no suspicious spot of congestion or abrasion. The entire drum-membrane was of a bluish black color.

January 7, 1916: Dr. Hasting's report: Patient rapidly improving; is up and around. Temperature has not been above 100° F. Pain much less in the neck and gone from the legs. (He had been given potassium iodid for about a week.) Watch heard two inches or so from the ear.

There is little more to report. Toward the end of January he went to Florida. On the way down there he had pain in the ear with swelling in front of the tragus. The hot douche promptly relieved this and there was no futrher trouble. It was probably a furuncle. When I last saw him, March 28, the membrana tympani looked quite normal. It was slightly grayish but the landmarks were distinct and the light spot brilliant. Hearing for a seventy-two inch watch was nine to twelve inches, and for whisper about twelve feet. There was no tinnitus, but at times a slight feeling of heaviness on the right side of the head.

As the story of an acute attic suppuration, this case is unimportant, but the question of the source and causation of such a severe spontaneous hemorrhage seems to offer an interesting field for speculation.

It seems unlikely that so rapid and profuse a flow could have come from any of the blood vessels usually found in the drum-membrane or middle ear, and the internal carotid, the lateral sinus and the jugular bulb suggest themselves as possible sources. An arterial source may probably be excluded since the dark color of the blood and the absence of spurting or even pul-

sation in its flow, as described by the patient, suggest a venous origin.

To consider it as coming from the sinus implies either an incompleteness of the bony partition separating this vessel from the tympanum or antrum, or a perforation of this partition by caries and an ulceration of the sinus wall without the formation of an obstructing thrombus. I do not think that any carious process existed in this case. The prompt disappearance of all mastoid symptoms after incision of the membrana tympani and it was punctured in an ordinary paracentesis. Under such conditions direct infection of the vessel wall from a suppurating middle ear might easily occur. Granting such an anatomical anomaly in this case the hemorrhage may possibly be explained by supposing that after the second incision of the membrana tympani the pus found its way into the lower tympanic cavity with resulting infection and ulceration of the jugular bulb. The two small hemorrhages in the morning came from a minute perforation in the wall which the clot was able to seal. The severe bleeding at night was preceded by coughing. During coughing or forced expiration the venous return from the head is impeded, the jugulars become distended and the pressure on their walls is increased. This effect is felt much more in the vein bulb than in the sinus. The weakened wall of the bulb could not withstand this suddenly increased strain due to the coughing and gave way. The flow was rapid enough to prevent clot formation in the middle ear or canal till the syncope slowed the circulation. Then the bleeding ceased. Its recurrence was prevented because the clot in the tympanum was held in place by the membrana tympani until either the wall was healed or the bulb occluded by a thrombus.

In an imperfect search through the literature I have found reports of hemorrhage from the ear in patients who were "bleeders," and cases of arterial hemorrhage following paracentesis of the membrana tympani have been reported by Dr. Selden Spencer[1], Dr. McKernon[2], and others. In Dr. Spencer's case the bleeding was supposed to have resulted from puncturing an aneurism of some tympanic artery, while in McKernon's, the supposition was that an artery had ruptured previous to the paracentesis. In his article, Dr. McKernon mentions a case reported by Dr. Dench[3], where in operating for removal of the ossicles the jugular bulb was opened with a curette, severe venous hemorrhage resulting, and later jugular thrombosis.

There was evidently here a dehiscence in the tympanic floor. He also refers to cases reported by Ludwig[4] and Hildebrandt[5], in both of which severe venous hemorrhage followed a paracentesis in the lower part of the membrane. Evidently in these the bulb must have been well up within the tympanum. These were operative accidents and I have found a report of spontaneous hemorrhage such as occurred in the case here presented. The three cases of venous hemorrhage quoted, however, confirm the anatomic condition upon which rests my theory, for it is only that, of this being a jugular bulb hemorrhage.

Another interesting feature of this case is the absence of subsequent suppurative complications. Up to the time of the hemorrhage there had been a purulent discharge from the ear and for several days after it an infection of the lateral sinus or jugular, or at least a breaking down of the clot in the middle ear with recurrence of the bleeding was feared. Nothing happened, however; there was no reaction and the existing suppuration ceased at once and permanently. Was it because the infecting organisms had so far lost their virulence that those left after this thorough flushing of the ear were unable to maintain themselves?

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Humboldt Building.

A Direct and Rational Method in the Treatment of Fractures of Lower Jaw. DR. CAVALIE, *Annali di Odontologia*, Feb., 1916.

The author's method comprises three stages: (1) Reduction and levelling of fragments; (2) establishment of the relations of the lower jaw with the upper arch; (3) retention in good position. Of 420 cases treated, his results were: 200 perfect recoveries, 200 on way of recovery and in the remainder, in which the bone destruction was extensive, he has obtained a pseudoarthrosis with correct position of fragments and arch. P. F.

RUPTURED ANEURYSM INTO THE MEDIASTINUM AND DEEP CERVICAL FASCIA WITH SYMPTOMS OF LUDWIG'S ANGINA. REPORT OF THREE CASES.

DR. EDGAR M. HOLMES, Boston, Mass.

On Aug. 16, 1897, a spare muscular man of 58 years, consulted me for a distress in his throat which he had had for a number of weeks and which he described as a gripping of the deep structures of the neck. For a year and a half he had suffered pain in the back and in the abdomen, and for three months he had been unable to work, and had not dared to eat much, as eating seemed to increase his distress. He complained of a nervous feeling in his feet and legs, and of getting dizzy upon arising quickly and upon taking a long breath. Examination of the throat showed nothing abnormal until after exercise when there was a distinct spasm of the left arytenoid and cord. There was a distinct whirring sound syncronous with the systolic sound which was distinguished over the second intercostal space and also over the abdominal aorta. A diagnosis of probable aneurysm was made and the patient was instructed to lead a very quiet life. On Oct. 10, I was given a very hurried call to visit this patient. I found him braced up in bed and breathing very hard. The attack had begun about an hour before. There was a feeling of distress in the chest and a beginning fullness in neck which had rapidly become swollen. When I saw him the neck was much swollen from the ramus of the maxilla to the clavicle. The color of the skin was the dark red so frequently seen in phlegmon. The mouth and pharynx were intensely injected, as was the larynx. The left cord appeared fixed in advanced phonation. The neck had the brawny feel of septic cellulitis. The pulse was about 55 and the temperature was 96.8°. Had I not known that the patient had an aneurysm, even with the rapid onset and the lack of temperature and pulse usually associated with septis, I feel I would have been led, by the otherwise striking picture, to make a diagnosis of septic cellulitis (Ludwig's angina). As it was it seemed very probable that there had been rupture into the superior mediastinum, and that the blood had been forced into the cervical tissues. After about three hours the patient became much more comfortable. The left vocal cord was in the cadaveric position. The pulse was weak and 90. I then left the patient in charge of a nurse who reported that (except for the painful pressure of the

swollen neck) he had had a fairly comfortable night until about six o'clock in the morning, when a violent cough was followed by a profuse flow of blood from the mouth, and by almost immediate death. Permission for autopsy could not be obtained, yet I believe our diagnosis a very reasonable one.

On Feb. 21, 1899, I was called in consultation by Dr. F. E. Bundy and saw and recognized my second case of ruptured aneurysm into the mediastinum, which had dissected into the intra-fascial spaces of the neck and sub-maxillary area above, producing the signs and many of the symptoms of cervical plegmon, so generally called Ludwig's angina. The patient, a man in his early sixties, had been an excessive drinker of alcoholic beverages since his college days, until two years previously, when he had stopped drinking upon the advice of a physician, as he began having severe neuralgia pains in both legs and in the back. These pains continued with varying severity and there were spells of numbness in legs, lasting from a few minutes to several hours. For about a month before the onset of our present consideration, he had been feeling much relieved, and was much encouraged when, at about three o'clock in the afternoon, without warning, he experienced sharp pains in the neck and chest, soon followed by hoarseness, some dyspnea and swelling in the neck. These conditions increased and Dr. Bundy, who was called in immediately after onset, called Dr. Wm. Bullard and me in consultation. I saw the case in about twenty-five minutes after the beginning of the attack and found the man in much distress. The dyspnea was very marked. The neck had much the appearance of a marked goitre except the color of the skin was that common to inflammation. The pulse had spells of being very slow, 40 to 45 per minute. Then there would follow attacks of tachycardia, 150 to that which I was unable to count. The dyspnea varied much, but not coincidently with the varying heart action. To the finger the neck had the same feel as in severe local cellulitis. The mouth, pharynx and epiglottis were intensely hyperemic. The arytenoids and ventricles of the larynx had an edematous appearance. The principal hindrance to breathing was found to be a spasm of the left recurrent laryngeal nerve. The left cord was, during much of the time, carried beyond the normal position of phonation. Percussion over the chest showed enlarged heart area dullness. The apex beat during the tachycardia, was in normal position. There was dullness to the left of the spine over the back. The heart sounds were normal and the auscultatory

sounds were those associated with laryngeal stenosis. I was of the opinion that we had to deal with a ruptured aneurysm or a ruptured abscess cavity within the mediastinum which had dissected by hemorrhage into the deep cervical fascia. Dr. Bullard who did not arrive until about an hour after my examination, and after the intense symptoms had subsided, was of the opinion that we were dealing with an acute thyroiditis with its syndrome of neurosis. At this time the spasm of the larynx had subsided and the heart action was more nearly within normal limits. The patient, fearing another attack, wished me to remain with him as he believed intubation might be necessary. At about nine o'clock while he was talking, and, except for the pressure in the neck, seemed fairly comfortable, he cried out sharply with pain, and was almost immediately in the same condition as I at first found him. This attack lasted about an hour and a half, when he became easier and remained so until 3:30 a. m., when another attack occurred which lasted until nearly five o'clock. Except for an increase in the laryngeal edema, the physical examination at this time was the same as the evening before. He remained comparatively easy, but extremely nervous, being able to converse with a very hoarse voice, and able to smoke cigarettes constantly until after eight o'clock, when the last attack occurred and he died in about twenty minutes. It was impossible to count the pulse for the last fifteen minutes of life. An autopsy found the collapsed walls of an aneurysm of the transverse aorta which ahd ruptured into the mediastinum and dissected into the tissue of the neck. Adhesion with the pericardium had prevented the flow of blood into that sack. There was erosion of the vertebra. The autopsy showed the cause of the two years' illness and the final symptoms and signs.

On Oct. 3, 1914, I was given a consultation slip at the Boston City Hospital to see a man who had been admitted on Dr. Jackson's service the previous day. The only history our service had was that two days previously the neck began to swell and was very painful. Examination showed a powerfully built man, 46 years of age, with the swelling of the neck of that intense brawny character found in very acute cellulitis. The subglossal tissue was very much swollen, the palate and uvula and all the pharyngeal mucous membrane were much swollen and there were several small areas of hemorrhage into the membrane. The epiglottis was like that of severe edema except the color was

darker. The larynx was congested. The temperature was 100.8, pulse 110. We made a diagnosis of probable Ludwig's angina. The following morning the patient was much more comfortable. The swelling was somewhat less and we did not disturb him to make more than a superficial examination. He remained moderately comfortable until early evening when he became suddenly worse and Dr. Place saw him in an emergency, and was of the opinion that the case was not an infection, as the temperature had dropped to about normal. The following morning I again examined the case, and at this time there were areas of ecchymosis of the skin and neck and upper chest as well as of the mucous membrane of mouth and throat. At this time we received the medical history and were able, with this and the existing signs, to make a fairly positive diagnosis of ruptured aneurysm into the mediastinal space and extension into the deep cervical fascia. Had we used due care and obtained the medical records before our first examination, we should have made a correct diagnosis at once. After remaining in the hospital six days, the patient demanded his discharge and went to his home, where, after another week, he died, and at the autopsy it was found that a rather large aneurysm had ruptured and dissected into the cervical tissues as we had presumed.

In conclusion, we find that all three of these cases, although they presented signs of infectious cervical cellulitis, had had symptoms suggestive of thoracic aneurysm, lasting for many months. The onset in all was more sudden than even the severe infections. They all began with severe, sharp, cutting pain with a feeling of much anxiety. The first two cases had no elevation of temperature. The third case had only slight elevation 100.8, and was followed by a subnormal temperature, 96, while the pulse was 120, and the respiration was 35. All these cases had a pulse rather above 100.

The prognosis must always be bad and the treatment can only be expected to alleviate distress and should be administered to that end. Incision into swollen areas, even though they fluctuate, would probably result seriously, and the practical lesson we may learn from these cases is to not forget the possibility of a similar condition when considering any case of severe cellulitis of the mouth, pharynx and neck, and not to incise for any supposed pus collection until we have reasonably eliminated this as an etiological factor.

531 Beacon Street.

EPITHELIOMA OF THE LARYNX TREATED BY RADIUM.*

DR. CORNELIUS G. COAKLEY, New York City.

Mr. D. J. M., age 71 years, was referred to me on Nov. 19, 1913, by Dr. H. F. Cook, of Newark, N. J. Several months ago he suddenly became hoarse and has remained so ever since; no pain, no cough, no expectoration. He had had some local treatment by several physicians without any apparent relief. On examination, the nares and pharynx were practically normal. In the larynx there was almost complete fixation of the right vocal cords, and a reddish, slightly nodular mass occupying the anterior two-thirds of the right vocal cord. The width of this mass was about three times that of the opposite normal cord, and in the center of the upper surface there was a grayish appearance as of ulceration. The clinical diagnosis was epithelioma. On November 21, 1913, a portion of the mass was removed by indirect laryngoscopy, and the tissue sent to Dr. Jas. Ewing, for microscopical examination. The following report was received by Dr. Ewing on November 24. "The tissue from the larynx of your patient shows typical epithelioma. There is a slight papillary tendency of the surface growth, but most of it is infiltrating the subepithelial tissues. Pearl formation and keratosis is not marked, but the cell type is quite atypical and malignant. At one point the lesion is ulcerating." The patient was advised to have a thyrotomy and growth excised. This he refused. On December 24, 1913, Dr. Howard Kelly, of Baltimore, applied radium to the exterior of the neck, and I have had the privilege of examining Mr. M. at frequent intervals since that time, and noting the effect of the radium therapy. A summary is appended.

December 31, 1914. Slight congestion of the laryngeal mucous membrane. No apparent change in the mass. January 3, 1915. No apparent change in the mass. General redness of the epiglottis and arytenoids. The mucous membrane of the larynx, other than the growth and the visible tracheal mucous membrane, has the appearance as if the patient had a very severe acute laryngitis. On the exterior of the neck from the clavicle to just below the upper portion of the thyroid, there is a superficial dermititis like a slight x-ray burn, not much induration, but tender on being touched. January 7, 1915. Dermititis of neck very marked; patient more hoarse than

*Read before the New York Academy of Medicine, Section on Laryngology and Rhinology, March 22, 1916.

usual, and there is a sort of gelatinous appearance to the laryngeal mass; this mass seemed somewhat larger. January 10, 1915. Dermatitis of neck slightly more pronounced; there is considerable desquamation; voice more husky than at any time since under my observation. There is some diminution in the size of the epitheliomatous area, and very marked congestion of the anterior portion of the left (healthy) vocal cord. January 14, 1915. Large, superficial ulceration, 2 inches long and 1½ inches broad on the exterior of the neck, less congestion of the epiglottis and interior of the larynx. Epitheliomatous area in larynx approximately one-third the size it was formerly. There is much greater space in the posterior portion of the larynx. Voice very husky, though a little better than at last visit. January 21, 1915. Mass in larynx somewhat smaller than at last examination. Externally there is a nodular hard mass about 1 inch above the ulceration on the right side. This mass is one and one-half inches long, one-half inch wide and one-half inch thick. February 13, 1915. Laryngitis improving. Intralaryngeal mass about one-third the size it originally was. There were a number of large furuncles on the neck, some of them one-half the size of an English walnut. There was a general thickening of the perichondrium of the larynx. Voice improving but still aphonic. Superficial burns nearly well. February 25, 1915. Voice still husky, though slightly improved. Anterior portion of the cord considerably thickened and has a slight grayish exudate over it. Perichondritis still marked, but somewhat improved. March 11, 1915. Voice somewhat better than at any time, but still hoarse. The anterior one-fifth of the right vocal cord is covered with a gelatinous exudate. We estimate that about 75 per cent of the infiltration of the right vocal cord has disappeared. On March 18, 1915, patient had another application of radium and on March 23, the mucous membrane was congested and the voice more hoarse. March 25, superficial ulceration on the neck appeared and the interior of the larynx was moderately congested. Voice more hoarse than for some weeks. March 28, large ulceration of the skin over the larynx; voice more hoarse than at any time. Laryngeal mucosa not so greatly inflamed as after first dose of radium. Considerable burning. Infiltration of the tissues external to the larynx. We believe that the impairment of the voice is due to a myositis of the extrinsic muscles of the larynx, rather than to the inflammation of the vocal cord. April 22. Voice but slightly improved. Considerable thickening of the tissue over the exterior of the larynx. May 27, very little change. June 3, movement of the right vocal cord still much

less than that of the left vocal cord; grayish exudate over anterior one-quarter of right vocal cord; still has burning pain in throat. October 7, neck entirely healed, but tender. There is some thickening around the larynx externally. Right vocal cord does not move as freely as the left. Some thickening and slight induration at the anterior third. Not much change from what it was when last seen in the spring. Voice hoarse and no better than three months ago. October 26, some little pin-point, reddish nodules on the upper portion of the right vocal cord anteriorly. Voice is anything but satisfactory. The right vocal cord moves less than it did in June.

Since reporting this case at the Academy in November, 1914, I have seen this patient about every ten days. Up to February 9, 1915, there was but little change in his voice or laryngeal condition. On this date there appeared to be a nodular thickening of the right vocal cord, and on February 12, 1915, I removed with laryngeal forceps a portion of this thickened area, and sent it to Dr. Ewing for pathological examination. He reported as follows:

"The portion of tissue from the vocal cord in the case of Mr. Mallon, received February 13, measures 2x1 mm., and is composed of dense hyaline connective tissue in which lie masses of atypical epithelium presenting the characteristics of equamous cell epithelioma. Some of the cell masses contain concentric, hornified cells, surrounded by flat cells of the pavement type, and in others the cells are smaller, more compact, but with hyperchromatic nuclei. The cells appear to be well nourished and capable of growth, but no mitotic figures were found. In the original specimen, the tumor cells were chiefly of the flat type. (Signed) J. EWING."

On March 16, 1915, patient went to Baltimore, where 1800 milligrams of radium was applied on outside of neck for five hours.

On March 30, 1915, both cords red. Trachea above red and congested. Voice very much worse. Severe dermititis on outside of neck. April 3, 1915, arytenoids very red and congested. Whisper voice. April 7, 1915, larynx very much swollen—both sides swollen and red—and injected. Voice very bad. Exterior of neck not burnt, except perceptible. May 1, 1915. Enormous infiltration on the outside of neck. Considerable edema of the left vocal cord. Patient was seen about every ten days, and but little change was noted until September 12, 1915, when it was observed that skin on outside of neck in the region of larynx very much thickened—very firm, and quite red. There are three small areas of ulceration, now covered with granulation tissue. Voice still very hoarse, though somewhat improved over last visit. There seems to be a slight increase in thickening of the right vocal cord anteriorly.

On December 16, 1915, voice very bad; good deal of secretion, marked thickening of the tissues exterior to the larynx—on both sides, superficial ulceration and scabbing of interior of larynx; has the appearance of acute laryngitis.

I have continued to see the patient about every ten days up to the present time and there has been little or no change in the voice or appearance in the larynx.

The conclusions that may be drawn from a study of this case are:

First. That radium applied externally has caused a marked diminution in the size of the carcinomatous infiltration of the right vocal cord.

Second. That the vocal cord moves now more freely than before the radium was applied.

Third. That the former site of the tumor is occupied pretty constantly with a grayish exudate; whether this is or is not at the present time some evidence of the malignant infiltration, can only be determined by microscopical examination of another section.

Fourth. Voice is not as good as when first seen.

Fifth. Voice is not as good as patients usually have following a hemi-laryngectomy.

Sixth. The late appearance of the infiltration of the neck, which appears to be due to the action of radium, rather than to secondary malignant deposits in the tissues.

Seventh. On the other hand the patient is in good health, and has taken on ten pounds in weight during the past year.

Eighth. From my experience with malignant growths, I believe that had he been allowed to go untreated either surgically or with radium, the disease probably would have resulted fatally before this time.

53 West Fifty-sixth Street.

Gluck's Laryngectomy in Cancer of the Larynx. R. BOTEY, *Rev. de Med. y Cirur. prac.*, Jan. 14, 1916.

From results obtained in eleven cases the author favors the Gluck operation of total extirpation of the larynx for intrinsic cancer and considers that 30 per cent of such cases show no recurrence after two years. P. F.

THE USE OF "TISSUE JUICES" FQR THE CONTROL OF BLEEDING IN TONSILLECTOMY.

Dr. Joseph B. Greene, Asheville, N. C.

It is not my intention to add to an already over-large literature on the technique of tonsil removal, but simply to suggest a procedure which has seemed to me to favor the clotting of blood, thereby lessening hemorrhage during the operation, and at the same time to facilitate accuracy of dissection. Without entering into a full review of the complicated processes concerned in the coagulation of blood, some of which are still unsettled, it seems advisable, in order that my procedure may be more clearly understood, to recall a few of the accepted factors concerned in the clotting of blood. It is a well known fact that blood does not normally clot in the body. The clotting is due to the action of thrombin or fibrin ferment on the fibrinogen of the blood, forming insoluble fibrin of the normal blood clot. Thrombin exists in the blood as prothrombin which, when acted upon by calcium salts, is converted into thrombin. As these elements are present in the normal circulating blood without clotting, there must be another element necessary for the formation of fibrin. It is thought that there is a small quantity of antithrombin present in normal blood which renders the thrombin inactive, but when blood is shed and flows over wounded tissue, the other element, thromboplastin, is supplied which neutralizes the anti-thrombin. This substance, which Howell terms "thromplastic substance" is abundant in "tissue juices," and is formed in wounded tissues from blood cells, blood platelets, and tissue cells. Howell[1] prefers to call these products "thromboplastic substances," "since this term does not commit us to the manner of their action, but simply implies that they are of importance in the formation of the clot."[2]

The method of tonsil removal which I shall describe attempts to make the fullest use of these "thromboplastic substances" contained in the tissue juices of the tonsil and adjacent tissues. After having employed this method in my own operations for some time, my attention was called to a paper of Dowman[3] entitled "Hemostasis, with Special Reference to Its Employment in Surgery of the Brain," in which he mentions the fact that the late Sir Victor Horsley was in the habit of applying a muscle tissue to prevent hemorrhage in brain operation. In this connection, I am authorized to quote from a personal letter from Prof. Howell of the Johns Hopkins University, in reference to the subject under consideration. He says: "Your procedure can certainly be depended on *a priori* grounds as

introducing a favorable condition for clotting. The point is the clotting of blood is much favored by tissue juice, the so-called thromboplastic action of the tissues. In dissecting off the tonsils there is much wounding of the tissues, but by your procedure of laying back the tonsil you add something to this exposure of the oozing blood to the tissue juice of the lacerated tissue and thus help its process of clotting."

The procedure which I shall describe has no application to other than the dissecting operation, usually begun with some form of dissector, and terminated with the wire snare. The exact details of this dissection are not important, except that pressure is exerted on the tonsil with a gauze sponge at each point in the dissection as bleeding is encountered. It is my custom, as I believe it is with the majority of operators, to begin the operation by freeing the upper part of the tonsil from its intimate relation to the pillars and soft palate, and completing the dissection of the lower half or third of the gland with the wire snare. The point in this paper which I wish to emphasize is the importance of exerting firm and even pressure against the tonsil in the fossa for a minute or two as vessels are encountered, in order to control hemorrhage promptly and the operation to proceed in a bloodless field. The absence of blood in the pharynx facilitates accuracy of operation, an advantage which we have all observed in operating with a local anesthetic. The importance of sparing as much as possible, not only of the delicate muscular tissue, but also the mucous membrane, is too evident to need emphasis from me.

Both Makuen[4] and Kenyon[5] have emphasized the importance of the subject from the standpoint of the voice. There can be no question of the lessened soreness of the throat and a more rapid convalescence following a careful and painstaking tonsillectomy. This fact alone justifies us in taking the utmost care in our tonsil work even if a little more time is required than is usually thought necessary for the completion of the operation. I have never had cause to regret time consumed in the operation, provided the end found the pillars left in perfect order and the mucous membrane remaining.

It has seemed to me also that less trauma is produced by the pressure of the tonsil in its fossa instead of the frequent use of gauze sponges, as is usually required after a hasty removal of the gland. While the quetion of shock is not a vital one in tonsillectomy, yet we should not ignore the work of Crile and other general surgeons, who have emphasized gentleness in the handling of tissues in surgical procedures. When this method of tonsil removal is

carried out, it is noted that on completion of the operation with the wire snare, preferably by slow compression, there is usually very slight bleeding and sometimes none at all. Should a vessel continue to bleed, it can be readily seized with artery forceps and ligated if necessary. We can also profit from the teaching of Halstead of the Johns Hopkins Hospital, who has pointed out to us for years the importance of sparing the patient all the blood possible in surgical operations. It not only lessens shock, but also facilitates convalescence and lessens the danger of infection.

Recent papers by Manges,[6] Richardson[6] and Coakley[6] have called our attention to the danger of lung abscesses and pneumonia following tonsillectomy, due probably to inhalation of blood and infected particles from the tonsil during the course of the anesthesia. If the danger of these unfortunate complications can be minimized by a careful prevention or lessening of hemorrhage in our tonsil operation, we are justified in consuming a little more time in this important operation.

While this procedure finds its greatest use in operations under general anesthesia, it is likewise useful in operating on older children or adults under local anesthesia where annoying hemorrhage may be encountered.

I hope no one will misunderstand me to advocate temporizing in the fact of severe tonsillar hemorrhage. Should this occur and pressure of the tonsil into its fossa fail to control the bleeding, the gland should be promptly removed and the bleeding vessel seized with a tonsil hemostat and the vessel ligated if necessary.

Summary. I wish to emphasize the following points: 1. The application of "tissue juice" to bleeding vessels in the tonsillar fossa shortens the coagulation time and stops bleeding.

2. This procedure affords one a relatively bloodless field which greatly facilitates accuracy of dissection.

3. Due to the loss of a minimum amount of blood and lessened trauma of the delicate tissues, shock is less likely to occur.

4. Convalescence is more rapid and comfortable, as a result of lessened trauma and greater accuracy of dissection.

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IN MEMORIAM

It is with sincere regret that we chronicle the death of our esteemed friend and fellow in laryngology, David Braden Kyle, of Philadelphia. After an illness of but a few days, Dr. Kyle succumbed to acute pneumonia, October 23d last.

His death was a shock to his many friends who knew him as an active, lovable and earnest worker, a frank and generous friend, an eminent and brilliant special surgeon, a liberal-minded and far-sighted contributor to medical literature, and an influential and fearless champion of all that stood for higher standards and the greater accomplishments in the medical profession.

He was a graduate of Jefferson Medical College, 1891; a fellow of the American Medical Association; president of the American Laryngological Association in 1910; a member of the American Otological Society, the American Laryngological Association, the American Laryngological, Rhinological and Otological Society, and the American Climatological Society. Since 1896 he occupied the chair of laryngology and rhinology in Jefferson Medical College, and was largely instrumental in establishing at this medical institution the prominence of the laryngological department for which it has long been recognized.

He was an important staff member of a number of the best hospitals in Philadelphia, including the position of bacteriologist to the Philadelphia Orthopedic Hospital. He was one of the comparatively few American laryngologists to attain especial prominence as an authority in the bacteriological and pathological investigations in laryngology.

His contributions to medical literature were numerous and always to be relied upon as original, thorough and well worthy of the serious consideration of the best minds in our specialty. His

text-book on "Diseases of the nose and throat," has passed through five editions and has received universal recognition as one of the standard American classics in this special field of medical literature. Like his monographs, his text-book reflects the character of the man; its pages express his honest convictions, original ideas, respect and deference for the work of his fellows, and a democratic spirit that seemed to those who knew him well to be one of the predominate traits of his nature.

He was a comparatively young man, 53 years of age, working in his prime, and as the writer intimately knows, with many plans and ideas that his untimely and regrettable death will make impossible of accomplishment.

He was a real force in the up-building and progress of American laryngology; his judgment was reliable; his interest in the new thoughts of his associates was intensely stimulating and his participation in developing progressive ideas and acts could always be depended on by his friends.

Laryngology has lost a valuable, progressive champion; the medical profession will miss his timely counsel and active support; medical literature has been deprived of a splendid influence and his personal friends and associates sincerely and sorrowfully mourn the loss of a good friend and a distinguished man.

Even this brief memorial would be incomplete without a reference to his close and dearest companion,—his wife, and to her we offer an especial expression of sympathy in her bereavement.

M. A. G.